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Behavioural indicators of candidate enrichments for kennel housed dogs

BEHAVIOURAL INDICATORS OF CANDIDATE ENRICHMENTS FOR KENNEL HOUSED DOGS

by

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ABSTRACT

The welfare of kennelled dogs is often considered to be suboptimal and therefore to require "enrichment". This thesis examines the short-term reactions of dogs to a variety of potential enrichments. Where possible, comparisons were also made between two contrasting kennel environments, to indicate to what degree interest in enrichments is influenced by environment, as well as fulfilling species requirements.

Interaction with toys was investigated as an example of inanimate enrichment. Toys that made a noise and/or could be chewed easily were found to be preferred to more robust toys, suggesting that the latter may provide little enrichment.

Interactions with humans and conspecifics were investigated as examples of animate enrichment. Dogs in long-stay enriched (LSE) kennels preferred unfamiliar humans to familiar, while those in rehoming (RH) kennels showed no overall preference: therefore, the welfare benefit of different forms of human contact is likely to differ between facilities. LSE dogs also behaved differently depending upon the familiarity of conspecifics, with the greeting period at the beginning of the interaction more important for unfamiliar dogs, suggesting that familiarity is also an important factor when considering the effectiveness of conspecific contact as enrichment.

Comparing animate and inanimate enrichments, LSE dogs chose social contact (human or dog) over toys. However, their greatest interest was in the goings-on outside the pen.

The rapid habituation that occurs towards individual objects during play was shown, by measuring dishabituation, to be due to the overall stimulus properties of the toy rather than those within any single sensory modality. The time interval between presentations did not appear to be critical to habituation or dishabituation.

Behaviour indicating a switch from anticipation to frustration as enrichment is delayed was investigated but not determined. However, positive reinforcement training may have inhibited expression of frustration behaviour.

DEDICATION

For all the people who have ridden this rollercoaster with me.

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AUTHOR'S DECLARATION

"I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Research Degree Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author".

SIGNED: .... DATE: 21/2/11

ETHICAL STATEMENT

All studies in this thesis were reviewed by the Waltham Centre for Pet Nutrition Ethical Review board and the University of Bristol ethical review board.

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CHAPTER 1: GENERAL INTRODUCTION

1.1. What is environmental enrichment?

The term "environmental enrichment" is most commonly associated with alterations of the environment of zoo animals. It encompasses behavioural and/or physiological modification made in order to improve welfare, in terms of both implementation and assessment. However, environmental enrichment can encompass all captive animal environments and generally describes supposed improvements made to those environments (Newberry, 1995). Environmental enrichment was initially used in research to investigate the effects of experience on the brain (see Benefiel et al., 2005) but has subsequently been used as a means of improving captive animal environments. Chamove (1989) describes enrichment as 'an attempt to ameliorate problems caused by containment'. Definitions of environmental enrichment are often vague, and improvement is perceived subjectively but not proven (Olsson and Dahlborn, 2002).

Newberry (1995) defines environmental enrichment as 'an improvement in the biological functioning of captive animals resulting from modifications to their environment'. However, in one study, laying hens showed increased egg production and improved physiology in more impoverished battery cages and 'poor' welfare conditions compared to a more complex free range, 'high welfare' environment (Koelkebeck and Cain, 1984). Newberry's (1995) definition, if applied literally, would therefore label the battery cage as environmentally enriched compared to the 'free range' environment.

Other definitions focus upon the behavioural outcomes of enrichment. (Shepherdson, 1994 cited in Young, 2006) defines enrichment as alterations to the captive animal's environment that benefit the animal. The resulting behavioural changes are considered to be behavioural enrichment. Again this definition remains vague, it does not set out what it considers to be beneficial to the animal or how to measure and quantify these benefits. If the enrichment brings both benefits and costs to the animal, is it still considered to be environmental enrichment? The Behaviour and Husbandry Advisory Group (BHAG) (1999, cited in Young, 2006) restricts the definition of environmental enrichment to cover only zoo animals. However it does continue with the idea of behavioural alteration, suggesting that environmental enrichment should 'draw out species appropriate behaviours and abilities' to enhance welfare, although this begs the question as to what behaviours are 'appropriate' for a species. It also implies that if the species-appropriate behaviours are seen, then the welfare of the animal is subsequently improved.

Finally, Carlstead and Shepherdson (1994) define environmental enrichment as 'a practice aiming to provide environments of greater physical, temporal and social complexity that affords animals more of the behavioural opportunities found in the wild'. Despite again focusing on the behavioural aspects of enrichment, Carlstead and Shepherdson's (1994) definition does pose problems if used in all captive situations. Firstly, some wild behaviours are not considered appropriate for captive situations, and secondly, domesticated captive animals used in laboratory research do not have the 'wild' behavioural repertoires of their undomesticated counterparts, therefore reducing the relevance of this definition in the context of domesticated species: this issue will be expanded on later.

Environmental enrichment is also often used in a looser sense, to describe any situation where complexity is increased (Young, 2006). This contradicts the given definitions, unless positive behavioural modification and/or improved biological functioning have been shown to have occurred (Olsson and Dahlborn, 2002).

1.1.1. Is environmental enrichment an anthropomorphism?

Environment enrichment is often used as a means of improvement primarily aimed at people and only secondarily for the animals (Newberry, 1995). In the zoo environment, enrichment is often provided as a means of reducing unwanted behaviours, in order to increase visitor satisfaction (Young, 2006). For example, enrichment that successfully reduced aggression and stereotypies in zoo-housed gorillas improved public perception of the captive environment (Blaney and Wells, 2004). This does not take into account any effect on the animal, and it is often assumed, for example, that reducing stereotypies improves welfare, even though this is not always the case (Mason and Latham, 2004). In some cases stereotypic behaviour may not be a sign of poor welfare, since there is little correlation between stereotypies and other indicators of poor welfare (Mason and Latham, 2004). Environmental enrichment does not always solve the cause of the problem, so despite a reduction in stereotypic behaviour the welfare may not be improved and the behaviour simply redirected to something more publicly acceptable. A dog that chews its bed may instead chew a 'toy' when given the opportunity. However, the dog still exhibits chewing behaviour in some form and the cause of the chewing has not been identified and addressed (Hubrecht, 1993b).

In rehoming shelters, enrichment can be seen as a good way to bring the dogs to the front of the kennel and increase activity, enhancing appeal to potential new owners and therefore increasing rehoming success (Wells, 2004a). Wells *et al.* (2002b) found that even if unused by the dog, the mere presence of a toy in the kennel increased the chances of that animal being rehomed, despite the fact that an unused toy presumably provides no environmental enrichment for the animal. Although it could be argued that this is an indirect means of improving welfare, by assisting in removing the dog from the poor welfare environment more quickly, it does not necessarily improve their welfare directly. Enrichment in the rescue centre environment appears to focus around the modification of behaviour to improve the working environment and modifying behaviour to make the dog more desirable to potential new owners whilst only considering dog welfare as a secondary issue (Graham et al., 2005a).

The vague nature of the definitions of environmental enrichment bring into question not only the meaning of environmental enrichment but also its purpose as a means of improving captive animal welfare. If the focus of improvement is on behavioural and physiological modification, it is important to understand species and breed specific behaviours in order to attempt manipulation of them in a positive manner (Latham and Mason, 2004).

1.1.2. Aims of environmental enrichment

As with the definitions of enrichment, the aims associated with enrichment are often broad and relatively unclear. Environmental enrichment often focuses on increasing the animal's control of and choice in the environment. Conversely it can be used to try to stimulate learning and as a consequence, temporarily increase uncertainty and reduce control (Watters, 2009). The aims of enrichment are often shaped by the motivations behind the enrichment program (Mellen and MacPhee, 2001; Swaisgood et al., 2005).

Enrichment objectives include; the reduction of abnormal behaviour (such as stereotypies); increased normal (and more publicly acceptable) behaviour and increased diversity of behaviour; an increase in the use of the environment in a positive manner, leading to an improved coping strategy to challenges in 'a more normal way'; increased choice and control over the environment; and the reduction of stress to increase reproductive success (Chamove, 1989; Carlstead and Shepherdson, 1994; Shyne, 2006; Young, 2006; Watters, 2009).

Focusing the aims around what is considered 'normal' highlight the human approach to enrichment rather than considering the needs of the animals. Any lack of definition of 'normal' behaviour allows wide interpretation of the objectives (Overall and Dyer, 2005) and the danger of 'normal' being interpreted more as 'publicly acceptable'. For captive wild animals, 'normal' behaviour is often considered to be wild behaviour (Shepherdson et al., 1998), and the reduction of unnatural behaviour, such as stereotypic behaviour and increasing activity levels, is a common reason for instigating environmental enrichment programmes in zoos (Mason and Latham, 2004; Hosey et al., 2009). However, restrictions are often imposed, as the enrichment must not conflict with the need for a visible animal displaying publicly acceptable behaviour, as well as ease of husbandry and visual monitoring of the animals (Newberry, 1995; Young, 2006).

For captive wild animals, aiming to replicate the 'wild' behavioural repertoire in captivity is not always appropriate (Mellen and MacPhee, 2001; Hosey et al., 2009). The wild environment itself is very varied, requiring different adaptive behaviours in different areas, and the captive environment could merely be seen as a new environment for an individual or group of animals to adapt to (Shepherdson, 1998 cited in Mellen and MacPhee, 2001), although the animal has no choice to leave such a place. However, in the captive environment, it could be argued that behaviours such as avoidance of predators, fear of humans and masking illness and injury are undesirable despite being 'natural' or 'wild' behaviours (Mellen and MacPhee, 2001).

Domesticated animals do not always have the same 'wild behavioural repertoire' that can be aimed for when providing enrichment, leaving the term 'normal' further open to interpretation in captive environments (Fox et al., 1975). In some cases the domestication process may have removed the domesticated animal so far from its wild ancestors that the value of studying the behaviour of wild ancestral species in order to provide a better captive environment for domesticated species may be questioned (Barnard and Hurst, 1996). This is the case particularly for the domestic dog and to a lesser extent the domestic cat and horse (Clutton-Brock, 1999). The selection processes (both natural and artificial) resulting from the captive environment bring in to question what should be classed as normal behaviour (Newberry, 1995). There is also little point in providing clear aims for environmental enrichment in any captive situation if the terms used are not clearly defined. Environmental enrichment can encompass anything over and above the basic provisions in a caged environment, removing any differentiation between the simple provision of bedding material in a barren cage for a singly housed laboratory mouse, and the complexity provided by access to a multilevel environment with conspecific contact. Clearly a structured system is needed to quantify levels of enrichment over and above basic provisions (Benefiel et al., 2005). It is also important to re-evaluate enrichment programmes following their implementation to ensure that they are effective and meeting the aims initially set out (Chamove, 1989).

1.1.3. Advantages of environmental enrichment

'The welfare of animals can be seriously compromised by inappropriate confinement' (Wells, 2004b). Therefore wherever animals are confined, enrichment is a positive step towards improving welfare. Environmental enrichment can promote the expression of natural behaviours. In farm animal species, the animal's ability to cope with social and physical challenges can be greatly increased by being allowed to perform natural behaviours (Spinka, 2006). Enrichment also allows animals to perform behaviours that have previously been suppressed or thwarted (Olsson and Dahlborn, 2002).

Although environmental enrichment does not imply any particular standard of welfare (Benefiel et al., 2005) it often means that a welfare concern has been identified and is being dealt with. Positive effects of environmental enrichment on animal welfare have been widely demonstrated, including increased reproductive success and reduced aggression (Carlstead and Shepherdson, 1994; Van Loo et al., 2002). As well as often being seen as an indicator of poor welfare (Liu et al., 2006) stereotypic behaviours are also of concern for the public as they are seen as inappropriate and unacceptable. Stereotypic behaviours can be tackled in a number of ways such as genetic selection, pharmacological treatments, reinforcement of 'positive' behaviours and negative reinforcement. However, none of these address the underlying welfare problems. Environmental enrichment aims to treat the reason for the stereotypic behaviour without the side effects and potential negative welfare implications associated with treatments, such as drugs or negative reinforcement (Mason et al., 2007).

1.1.4. Types of environmental enrichment

Enrichment can be either animate or inanimate (Wells, 2004b). Animate enrichment covers the provision of social contact, both human (general contact and training) and conspecifics, whilst inanimate enrichment includes 'toys', cage furniture and spatial enrichment, olfactory and auditory stimulation, visual stimulation, food provision, cage rotation and cage structure (Mellen and MacPhee, 2001; Wells, 2004b; Tarou and Bashaw, 2007).

The importance of social contact is largely dependent on the species and to some degree the individual animal. Social species such as monkeys are likely to benefit much more from conspecific social contact than solitary species, increasing species typical behaviours (Line et al., 1991; Schapiro et al., 1996). The benefits of human contact are also species dependent. Domesticated species or tame animals are more likely to benefit from human contact than those that are not.

Training is a relatively new concept in enrichment. Despite its use for many years in environments such as zoos and for captive marine mammals, the importance of training as a means of enrichment for the animal is now better understood (Laule, 2003). Training can provide cognitive enrichment and increased human social contact, as well as reducing handling and stress on the animal during routine health checks and experimental work. It is important to highlight that this is only true for positive reinforcement training. The use of negative reinforcement and punishment techniques are likely to be detrimental to the animal's psychological wellbeing and reduce any positive association with humans (Laule and Desmond, 1998; Shepherdson et al., 1998; Mellen and MacPhee, 2001; Laule, 2003). However, even positive reinforcement training does not automatically encourage 'natural' behaviours. Pigs trained to put coins in a piggy bank for food, a behaviour completely unnatural to them, preferred to root through the coins despite the food reward for showing the desired behaviour (Mellen and MacPhee, 2001). It is therefore important that 'enrichment' training allows the animals to perform behaviours as close to their 'natural' behaviours as possible.

Altering the psychological environment of the individual is thought to have a marked impact on the mental wellbeing of the animal. Predictability in a kennel environment, such as the timing of feeding and exercise, has been found to reduce stress and fear in dogs (Hennessy et al., 1998). Unpredictability of feeding regimes in brown capuchins lead to reduced social behaviour and increased cortisol levels (Ulyan et al., 2006). Unavoidable unpredictability is thought to be temporarily stressful, until the new routine has been learned (Taylor and Mills, 2007). Conversely, too much predictability increases arousal or leads to a monotonous environment, suggesting that some level of unpredictability is positive (Taylor and Mills, 2007). Environmental unpredictability is commonly observed as a means of measuring and improving welfare (Ulyan et al., 2006; Bassett and Buchanan-Smith, 2007). Announcing the arrival of enrichment increased interaction with the given enrichment more than enrichment alone in weaned piglets (Dudink et al., 2006). However, when a predictable routine has been set, deviation from this routine in the form of delayed presentation of food may increase stress levels and anticipatory behaviour, observed in stump tailed macaques (Waitt and Buchanan-Smith, 2001) and rats (Bassett and Buchanan-Smith, 2007).

Inanimate enrichment techniques are generally used to enrich the home environment of the animal. Within the context of enrichment, 'toys' becomes a very loose term, generally encompassing any novel object such as dog 'toys', sticks, plastic blocks and other novel objects that the animal is given to 'play' with in order to increase both physical and mental stimulation (Line et al., 1991; Hall, 1998; Wells, 2004a). Enrichment of the cage itself can involve (but is not limited to) the inclusion of platforms and multilevel areas, places to hide, and substrate (Young, 2006). Again, this is very much species-specific and the behavioural needs and underlying motivation of the animals must be considered in order to provide appropriate enrichment (Swaisgood et al., 2005). Swaisgood and Shepherdson (2005) suggest cage rotation as possible enrichment in order to increase novelty. However, this must be approached with caution as such a major change may increase fighting in territorial animals and increase stress and reduce well-being as scents and familiarity will be lost. However, in male mice, partial cage cleaning (replacing substrate without cleaning the cage itself) increased aggression to a greater extent than transferral to a completely new cage, since they were not defending an already established territory (Gray and Hurst, 1995).

Food enrichment is one of the most common means of enrichment for captive animals, allowing the provision of necessary nutrients by novel means, often involving cognitive processing, problem solving and encouraging foraging behaviour seen in their wild counterparts (Meehan and Mench, 2007). However, if this is to encompass cognitive enrichment then it must extend beyond simple food searching and involve some level of problem solving. It could be argued that problem solving can lead to frustration behaviour but Meehan and Mench (2007) propose that this is necessary in environmental enrichment, and that so long as the animal can solve the problem to gain the food reward it is not detrimental to welfare.

Appropriate olfactory, auditory and visual stimuli are often overlooked in enrichment programmes that are designed from a human rather than animal perspective. Enrichment programmes that do include olfactory, auditory or visual enrichment are generally based around methods known to work in humans. For example, visual enrichment in the form of video stimulation for rhesus monkeys (Platt and Novak, 1997). However, Fleishman et al. (1998) highlight a potential limitation with video playback, since the visual processing of animal is, for the majority of cases, different to that of humans, reducing the likelihood of a match between the image perceived by the animal and the natural situation being portrayed. Olfactory stimulation has been implemented for gorillas using orange, vanilla, peppermint and almond (Wells et al., 2007). Olfactory cues such as essential oils have successfully affected behaviour, for example, reducing 'learned helpless' behaviours, such as increased resting and sleeping by increasing mental and psychological stimulation (Wells et al., 2002b; Wells, 2009). Wells et al. (2006) appears to be the first study to suggest the benefits of 'ecologically relevant' auditory enrichment on animal welfare rather than simply the music that is traditionally used. More natural enrichments for the animal appear to be overlooked. When, however, 'natural' sounds, for example, are considered, success may be more likely due to masking of other noises than any relevant auditory stimulation to the individual (Wells, 2009). It is necessary not only to provide olfactory and auditory enrichment to improve the well-being of the animals but also to consider the effects of the environment and husbandry routine they are exposed to. As previously mentioned, cleaning regimes have been shown to affect aggression levels in male mice (Gray and Hurst, 1995) whilst noise levels in animal housing facilities can reach around 100dB, a level known to be detrimental to human hearing (Sales et al., 1997).

Chamove and Moodie (1990) suggest that inducing arousal (by simulating an encounter with a predator) may be beneficial to laboratory animals, by allowing them an increased behavioural repertoire, a more natural environment and an improved ability to cope with environmental stressors. Although the study showed an increased behavioural repertoire and increased positive behaviour, their monkeys did not appear to have an improved response to environmental challenges (Chamove and Moodie, 1990). Meehan and Mench (2007) continue with this point, suggesting that some level of 'good stress' or 'eustress' may be necessary to maintain homeostasis and to cope with challenges. Although they do not identify what stress may be 'good', they do point out that some level of stress has been associated with improved cognitive function and learning (Meehan and Mench, 2007). However, Wells (2009) argues that the introduction of predatory animal odours may induce anxiety in captive animals.

Young (2006) puts forward two strategies for enriching environments; a naturalistic approach which aims to make the captive environment as close to that of the natural environment of the species, and a behavioural engineering approach which aims to encourage natural behaviour, although the environment may appear more man-made. The naturalistic approach is more visually appealing in public areas such as zoos. However, in a laboratory, farm or kennel environment with space, financial and hygiene conditions imposed, it is more likely that the behavioural engineering approach will be implemented. Enrichment should not be restricted to a definitive list but a constantly evolving programme specific to species and individual situations.

1.1.5. Measuring environmental enrichment

The success of environmental enrichment is difficult to measure. It is first necessary to look back at the aims of the enrichment program and subsequently find a means of measuring whether those aims have been met. If improving welfare is the aim, then as Newberry and Estevez (1997) conclude 'There is no ideal currency for assessing animal welfare although fitness...or other indicators of physical condition may be useful as starting points'. Animals are often provided with so many different types of enrichment it becomes very difficult to determine which ones are effective (Swaisgood and Shepherdson, 2005). Enrichment programmes should be closely monitored for effectiveness; there is little point providing ineffective enrichments, but simple interest in the enrichment does not necessarily mean that the animal's welfare has improved (Chamove, 1989; Swaisgood et al., 2005). Enrichment may be considered successful in achieving its aims, but when one enrichment provides a number of components (such as noise, food and manipulatibility) the underlying reasons for its success may be difficult to determine (Watters, 2009).

Three main techniques have been employed to investigate the success of environmental enrichment; behavioural, physiological and neurological, or a combination of the three (Young, 2006). Behavioural observations look at changes in behaviour and time budgets following enrichment. In order to use behavioural observations it must be assumed that the behavioural measures (such as reducing stereotypies and increasing the behavioural repertoire) are indicators of welfare (Swaisgood et al., 2005). Behavioural measures can take one of two approaches; either the change in behaviour following enrichment, or the alteration to behaviour when a specific task is given. For example, when looking at the effects of environmental enrichment in rabbits, a number of behavioural techniques were employed (Hansen and Berthelsen, 2000). The behaviour of the rabbits in the home cage was recorded, as well as any behaviour indicative of stress (such as bar-biting and excessive grooming). Rabbits were also exposed to an open field test to measure the effects of enrichment in the cage on behaviour outside the home environment and changes in the coping ability of the rabbits (Hansen and Berthelsen, 2000). Preference testing is a simple means of giving an animal choice and testing motivational strength between the stimuli (Kirkden and Pajor, 2006); for example, the preference of mice for bedding material was demonstrated by measuring the amount of time spent in an enriched and non-enriched cage (Van de Weerd et al., 1998). This approach is useful for determining animal preference but it must be remembered that the animal can only choose between the options given and neither may be optimal for that animal. Choice testing allows more in depth behavioural analysis of interest in particular enrichment whilst retaining an option of no interest (Kirkden and Pajor, 2006). Aversive effects of enrichment on behaviour can also be measured if there is concern over the enrichment reducing welfare. Aggressive interactions are commonly measured in these situations. Reductions in aggression have been studied in rodents, pigs and primates following the introduction of enrichment devices (Schaefer et al., 1990; Van Loo et al., 2002; Honess and Marin, 2006).

Physiological measures include stress hormones such as cortisol, immunology, body weight and reproductive state. Van Loo et al. (2002) used urinary corticosterone as a measure of stress levels and aggression in mice (alongside behavioural observations) following enrichment. However, in order to collect urine samples, it was necessary to isolate the mice on a weekly basis until urination occurred, which may in itself have induced stress. More invasive techniques have been utilised by Schapiro et al. (1993) in order to measure plasma cortisol in rhesus monkeys. However, this approach is dependent on the species being observed. It is much easier (and publicly acceptable) to regularly blood or urine sample a laboratory animal to measure stress hormones than to obtain regular samples in a zoo environment for example. Ideally, a combination of both behavioural and physiological measures is likely to give a better understanding of the success of environmental enrichment in improving welfare rather than one measure alone (Schapiro et al., 1996).

Neurological measures have allowed the measurement of brain function and cognitive abilities in order to assess welfare. However, the majority of studies have been carried out in mice and rats due to the invasive nature of the techniques and often require post mortems to be carried out on the animals at the conclusion of the experiment. Siwak-Tapp et al. (2008) used neurological techniques to investigate the effect of behavioural enrichment on neuron loss in dogs. Although the study suggested that behavioural enrichment might reduce neuron loss in aged dogs, the techniques were highly invasive.

The duration of any study into environmental enrichment is often determined by the availability of resources and animals. However, the simple novelty of a new enrichment device may alter behaviour and physiology in the short term but long-term may have no positive effects on welfare. It is well documented that 'toys' as a form of enrichment are quickly habituated to in a number of species (Wells, 2004b; Honess and Marin, 2006). Although precise definitions of 'toys' appears to be lacking within the literature, they have, in this instance been defined as manipulable objects. If the aim of environmental enrichment is a long-term effect on welfare, the measures of welfare should be assessed regularly, and rotation of enrichment considered to avoid habituation (Wells, 2004b; Young, 2006).

Habituation is an important consideration of enrichment that is often overlooked. This can take two distinct forms, satiation or fatigue to the behaviour induced by the enrichment, particularly where feeding enrichment is involved, or habituation to the stimulus properties of the enrichment (Vogel and Wagner, 2005; Hosey et al., 2009). In the case of satiation, reigniting interest in the enrichment may simply be a case of a renewed interest in that activity over time, such as feeding or playing. The enrichment would need no alteration to remain of interest (Hosey et al., 2009). Conversely, habituation to the enrichment as a whole (which may be combined with satiation) removes the appeal of the device or environmental change as enrichment. Habituation appears to vary between species and enrichment types. Feeding enrichments are considered slow in their habituation since they provide a continued highly desired reward (Tarou and

Bashaw, 2007). Without knowing what it is about the enrichment that the animals find enriching, it is almost impossible to determine which stimulus properties of the enrichment habituation has occurred towards and therefore how much alteration is necessary to reignite interest in the enrichment. Intermittent provision has also been used to successfully reduce or remove habituation to enrichment (Tarou and Bashaw, 2007). Habituation to enrichment introduced to reduce pacing in Sumatran tigers was successfully reduced when intervals of up to 4 weeks were introduced between presentations (Plowman and Knowles, 2003 cited in Hosey et al., 2009). Somewhat unsurprisingly, the most successful of these involved the inclusion of food enrichment. An alternative method of mitigating habituation is to alternate between enrichments. However, the memory of previous presentations of enrichments is likely to affect interest and therefore success of enrichment (Trickett et al., 2009). This effect may be further increased by altering the time interval both in presentation length and time interval between presentations, as in weaner pigs (Gifford et al., 2007).

1.1.6. Problems with environmental enrichment

Measurement techniques

The lack of consensus on which techniques to use and how to interpret results when measuring enrichment make it very difficult to determine how successful an enrichment has been. The level of success must be based around whether the aims of the enrichment have been achieved, and if one of these is to improve welfare, whether the behavioural, physiological and neurological changes observed are indeed an indication of improved welfare. However, simply observing that an animal interacts with the enrichment device or that a behavioural change has occurred does not automatically mean that welfare has been improved (Newberry, 1995; Swaisgood et al., 2005). Novel objects and situations introduced to an environment can be stressful and frightening for the animal and it should be accepted that not all enrichment techniques will be effective and may on occasion be detrimental to the animal (Mason et al., 2007). Inappropriate provision of objects may lead to increased frustration and redirected behaviours, such as tail-biting in pigs (Van de Weerd and Day, 2009).

It is difficult to gain a complete overview of all enrichment studies, as there is likely to be a reluctance to publish work on unsuccessful enrichment attempts. Studies finding negative or neutral effects of enrichment are rarely published (Wiedenmayer, 1998; Young, 2006), although aggression problems relating to the provision of 'toys' for primates have been noted (Honess and Marin, 2006). A further problem with standardising enrichment measurement is that it is often tested in relation to different baselines. A small barren cage enriched with basic bedding material cannot be directly compared to providing the same bedding in a large, free ranging more natural enclosure (Newberry, 1995). It is also worth considering that given the choice, animals may not always show a preference for the enriched area over a barren one (Bayne et al., 1992 cited in Honess and Marin, 2006), and that in preference testing the animal may simply choose the better of two bad environments without any significant increase in welfare. There is also the temptation to use enrichment devices known to work on other species. Although this is a useful starting point, the species' and individual's situation should be taken into account. Swaisgood and Shepherson (2005) point out that although a species-specific approach may be more time consuming to implement, it is more likely to provide effective enrichment and improve animal welfare. It could be argued that if a large number of different enrichments are provided, it is likely that some will be effective by chance. However, this approach may be detrimental to the animals' welfare, by causing stress due to unpredictability, and it would also be impossible to determine which enrichments had worked (Swaisgood and Shepherdson, 2005).

Stereotypic behaviour is generally considered to be undesirable, both in terms of public perception of the animals' environment and as a welfare concern. It is often thought that stereotypies are performed in an impoverished environment and therefore the animals' welfare is compromised. A positive correlation has been suggested in kennel housed dogs between physiological measures of stress, including urinary cortisol, and stereotypic behaviours such as circling (Beerda et al., 2000). However, Swaisgood and Shepherdson (2005) argue that stereotypic behaviour is a coping mechanism and therefore animals exhibiting stereotypic behaviour can be regarded as performing 'self-administered enrichment', and may have thus better welfare than animals in the same environment not showing stereotypic behaviour. Despite many studies that link stereotypies to poor welfare, many suggest they are not (Mason et al., 2007). Mason and Latham (2004) point out that stereotypic behaviour does have a role in welfare assessment and in many cases it appears where welfare is sub-standard. However, interpretation must be approached with caution and it should also be recognised that stereotypies can be present where there is good or neutral welfare (Mason and Latham, 2004). The reduction of stereotypic behaviour alone should therefore not be used as a sole indicator of improved welfare.

Short-term preference as a measure of enrichment

Preference testing and choice testing have previously been used interchangeably within scientific literature (see Faure, 1994), although "preference" is most commonly used for animal subjects, whilst human studies focus on "choice". Kirkden and Pajor (2006) suggest that choice and preference are two different constructs within the behavioural assessment of motivation and subjective state. "Preference" compares motivations to gain or avoid a stimulus or resource, therefore summarising the animal's internal state (Kirkden and Pajor, 2006). By this definition, preference is not directly measurable but instead looks at motivational strength. "Preference" cannot therefore be used for comparisons between resources satisfying different motivations such as 'resting' and 'eating'. "Choice" is a discrete measure of behaviour (for example, choosing to interact with toy A rather than toy B, or interacting with toy A for longer than with toy B) (Kirkden and Pajor, 2006).

Consumer demand studies provide a means of measuring this preference by looking at the strength of motivation to obtain various resources. By providing resources through clear Perspex weighted doors, the individual's motivational strength to reach each of the resources can be quantified (De Jong et al., 2007). This approach has been used in chickens (De Jong et al., 2007) allowing comparisons within categories such as substrate. In mink (Cooper and Mason, 2000), chickens (Dawkins, 1983) and mice (Sherwin, 1996) comparisons have been made between categories such as water vs. bedding to observe behavioural priorities. This approach allowed manipulation of choice to gain enrichments meeting different motivational needs by increasing the weighting of the doors. However, Cooper and Mason (2000) highlight that this approach still requires a measure of behaviour, since the increased weighting of the door affected the subsequent level of interaction and time spent with the enrichments offered. This approach in the kennel environment would have provided an alterative quantifiable comparison of preference within enrichment categories (such as toys) and choice between enrichment categories (such as human contact vs. toy vs. conspecific contact). However, the limited space to build a weighted door system on a scale suitable for dogs, alongside the necessary time needed acclimatise and subsequently train the dogs to use the weighted door system reduced it's usefulness as a potential measure within the kennel environments. It would also have retained the limitations met when designing the choice test study (Chapter 6). In order to provide physical conspecific contact, the non-focal dog would need to be tethered to stop it from moving between enrichments, an approach that may have compromised the welfare of the non-focal dog.

Choice testing can be a relatively simple to execute experimentally, and provides a useful short term assessment method to observe the potential success of longer term enrichment provision, on the basis that if a candidate enrichment is of little or no interest to the animal, it is unlikely to provide any benefit longer-term. However, the methodology does have some limitations as a starting point to predict potential enrichment. The choice of the individual for any given enrichment is likely to be influenced by other factors, depending on the strength of motivation for the enrichment. Observing interest in enrichments using choice testing does not automatically lead to a suitable enrichment long-term. Choice testing may suggest an animal's interest in the given enrichment but this does not evaluate the level of pleasure or improved welfare (Dawkins, 1976). However, it does provide a scale on which the value of enrichments at a particular point in time can be evaluated relative to one another (Van Rooijen, 1983).

Although short term choice tests will not determine which enrichments will be successful long-term, they give an insight into those which are likely to be favoured and therefore worth investigating further as potential enrichments. However, the properties of enrichment objects appealing to pigs altered to some degree over a five day period, suggesting a shift from short term to long-term attractiveness (Van de Weerd et al., 2003). To date, published studies into enrichment for domestic dogs have not used choice testing despite its potential as a short term behavioural measure.

Provision

Provision of enrichment can present further challenges. Providing enrichment can be costly and time consuming both in the initial set up and the maintenance of the enrichment devices (Tarou and Bashaw, 2007). Habituation can occur with any enrichment device. Once an animal has habituated to it, it may serve little or no purpose in improving that animal's welfare. Platt and Novak's (1997) study suggested that habituation can be reduced with the use of reinforcers (such as a food reward). When given video tape and video game stimulation, monkeys habituated only to the video tape in the trial period, since the video game provided a reinforcer food pellet (Platt and Novak, 1997). Enrichments such as training and social contact require extra man-hours to provide consistent enrichment, whilst 'toys', bedding and multilevel environments make cleaning more difficult and hinder the capture of animals (Hubrecht, 1993b). Laboratory housed animals present their own problems when trying to provide enrichment, since although enriched environments are arguably more likely to allow the animals to have behaviour and physiology closer to that of their wild or domesticated counterpart, any alteration of environment may affect experimental results and reduce the ability to compare the results to historical data in non-enriched environments (Sherwin, 2004). Conversely, abnormal behaviour indicative of an inability to adapt to the captive environment may alter the animal's physiology, in turn affecting the validity, reliability and replication of the experiment (Sherwin, 2004). The mechanisms underlying stereotypic behaviour in captive animals appears to be the same as those in humans, suggesting abnormal brain function (Mason et al., 2007). If this is the case, the results of behavioural experiments, at the very least, will be affected by the presence of stereotypic behaviours. However, the provision of nesting material as enrichment to laboratory mice did not adversely affect physiology and behaviour and therefore is not likely to alter experimental results (Van de Weerd et al., 1997). Van de Weerd et al., (1997) argued that studies are more biologically relevant if the animals have optimum welfare. The provision of 'toys' is also of concern in both the laboratory and zoo environment as a potential facilitator of aggressive interactions. Although in primates, appropriate enrichment has been found to reduce aggression, inappropriate enrichment, in one study, it was suggested increased aggressive interactions (Honess and Marin, 2006). Social contact may also lead to injuries, which is not only distressing for the animals involved but may also cause problems in laboratory experiments and animals farmed for meat. However, the importance of social enrichment and the benefits to welfare must be weighed up against the risk of injury and distress before social enrichment is denied. Natural behaviour such as the flight response induces stress, social aggression and suppression of illness which may be detrimental to welfare, and so it is important to determine which natural behaviours provide optimum welfare and what the consequences of thwarting behaviours will be (Spinka, 2006). Environmental enrichment is unlikely to be considered if it interferes with other constraints on the environment. In zoos this can include public perception, resources, space and conservation programmes. In the laboratory enrichment is constrained by protocols of experiments, disease risk, cost, space and regulation whilst on farms economics is a large factor alongside animal health and staff safety (Mench, 1998).

1.1.7. Summary of environmental enrichment

This section has summarised the value of environmental enrichment as a method of improving welfare of captive animals. It has highlighted some of the possible measures that can be used to determine whether a perceived enrichment may have the potential to be an effective source of enrichment for the animal. Within the suggested measures of enrichment, the pros and cons have been discussed. As a result, in this thesis I have used behavioural measures alongside choice testing in order to investigate potential enrichments for kennel housed dogs.

1.2. The domestic dog

1.2.1. Origins of the domestic dog

Domestication is a form of mutualism between human and animal populations. The human element is a necessity in order to care for the animals (Zeder et al., 2006). The domestic dog is thought to be the first species to be domesticated by humans (Clutton-Brock, 1995). It is likely that the domestic dog evolved through taming of ancestral wolves which remained close to human settlements followed by the eventual reproductive isolation from the wolf species (Clutton-Brock, 1999). The process of domestication involves a biological and a cultural stage. The biological process leads to reproductive isolation of the species, whilst the cultural process involves the merging of the species into the human society and beginning of ownership of the species (Clutton-Brock, 1995).

It is now accepted through genetic analysis, that the domestic dog (*Canis familiaris*) originated from the gray wolf or one of its ancestors (*Canis lupus*) (Bradshaw and Wickens, 1992; Leonard et al., 2002; Cooper et al., 2003; Ostrander and Wayne, 2005) although the exact route of domestication is still disputed (Cooper et al., 2003; Boyko et al., 2009). It is unclear whether the domestication process occurred at a single point or whether the dog has multiple origins (Savolainen et al., 2002; Morey, 2006). The archaeological evidence proposes a domestication event around 14,000 years before present (Clutton-Brock, 1995), however, genetic analysis suggests a divergence from the wolf over 40,000 years before present (BP), even as far as 100,000 years BP (Savolainen et al., 2002; Bradshaw, 2006). Arguments for the widely differing dates between the archaeological and genetic evidence include effects of domestication on the rate of mutation.

Archaeological analysis examines the morphology of excavated bones of Canids found buried with humans. This method not only relies on finding early human settlements but also on a capacity to distinguish between tamed wolves and early dogs, since physically they are so similar (Clutton-Brock, 1999; Savolainen et al., 2002; Ostrander and Wayne, 2005). Vilà (1997) suggests that early domestic dogs were morphologically too similar to wolves to be distinguished through archaeological evidence. Only when the hunter-gatherers adopted sedentary living did the domestic dog show morphological differences to the wolf, going some way to explaining the genetic and archaeological differences in the date of domestication (Clutton-Brock, 1995; Vilà et al., 1997; Wayne and Vila, 2001; Bradshaw, 2006). The earliest domestic dog remains found date from 14,000 years BP in Germany (Leonard et al., 2002; Savolainen et al., 2002; Ostrander and Wayne, 2005). However, the location of the origins of the domestic dog is still widely disputed, although somewhere in East Asia is currently considered most likely (Leonard et al., 2002; Savolainen et al., 2002; Ostrander and Wayne, 2005); presumably this must therefore have been earlier than 14,000 years BP. However, as genetic techniques advance, the idea of an East Asian origin continues to be called into question (Boyko et al., 2009).

Genetic evidence uses rates of mutation in non-functional mitochondrial DNA to determine a date for the first domestic dog (Savolainen et al., 2002; Parker et al., 2004). Savolainen et al. (2002) suggested that the domestic dog originated from 5 female wolf lines (as opposed to the previously suggested four), which would reduce the estimate of the date of origin of the domestic dog compared to a single origin. The date would also be affected by likely backcrossing between early domestic dogs and their wolf ancestors (Wayne and Vila, 2001; Ostrander and Wayne, 2005). If one of the later dates for domestication is correct, dogs must then have spread rapidly around the world (Clutton-Brock, 1995).

1.2.2. What effects has domestication had?

The domestication process has greatly altered the domestic dog from its wild ancestral species. Comparisons to the gray wolf highlight many physical and behavioural differences with the domestic dog (Fox et al., 1975). Physical differences, particularly of the mandible, are often emphasised since they are the main means by which archaeologists have distinguished between early domestic dogs and their wolf ancestors (Olsen and Olsen, 1977). The jaw of the dog is generally slightly shorter than that of the wolf with increased crowding of the teeth and dental overlap (Davis and Valla, 1978). However, some features, including dental overlap, are not exclusive to the dog and may also be present to some degree in the wolf at certain stages of its life (Davis and Valla, 1978). Other physical differences include a shorter, wider muzzle in the dog, and reduced body size and alteration in limb proportions. This is likely to be due to adaptation to human society and artificial selection of preferred characteristics (Clutton-Brock, 1995). The female wolf breeds once a year, whilst most dogs are able to breed twice a year unrestricted (Raab, 1967; Houpt and Willis, 2001). Alongside this, domestication has elicited alterations in coat colour and position of carriage of the tail and ears. As the domestication process continued, some of the survival characteristics of the wolf such as a low threshold for fear and low stress tolerance have been replaced by a docile nature and suppressed reactions to fear and stress (Clutton-Brock, 1995). Physiological changes occurred, including reduced brain size, hormonal changes, the reduction of visual and auditory acuity and the move from howling to barking for communication in dogs as well as paedomorphosis (the retention of juvenile characteristics as an adult,) (Clutton-Brock, 1995; Goodwin et al., 1997; Houpt and Willis, 2001). These changes would have been due to both the adaptation of the dog to the demands of the human environment, and selective breeding of the dogs to retain favourable characteristics (Parker et al., 2004).

Paedomorphism, both physical and behavioural, has had a marked effect on the differences between the domestic dog and the wolf (Goodwin et al., 1997). Behavioural analysis by Goodwin et al. (1997) compared the signalling abilities of domestic dogs with their physical appearance, in comparison with that of the wolf. Those dogs showing high levels of physical paedomorphosis showed reduced lupine signalling abilities. The remaining signals were those that develop very early in the wolf pup, suggesting a link between physical and behavioural paedomorphosis (Goodwin et al., 1997). Genetic analysis has allowed the construction of phylogenetic trees grouping genetically similar breeds together and highlighting those breeds genetically closest to the wolf (Parker et al., 2004), which may therefore have the most wolf-like signalling repertoires. Major changes in the physical appearance of the dog brought about by continued selective breeding have altered the dog's ability to signal not only from that of the wolf but also their ability to communicate effectively with other dogs. Shortening of the muzzle, tail and hair to name but a few have, in many breeds, altered areas of the body crucial for effective signalling between dogs (Clutton-Brock, 1995; Kerswell et al., 2009).

1.2.3. Comparisons to feral dogs

Research into dog behaviour often compares domestic dogs to their ancestral species, the wolf (*C. lupus*). However, it is becoming clear that domestication has left the domestic dog (*C. familiaris*) quite far removed from the wolf both physically and behaviourally. Because of the confinement imposed on the domestic dog in the home environment, often in isolation from conspecifics, it becomes difficult to study 'normal' behaviour (Fox et al., 1975; Boitani et al., 1995). Free ranging and feral dogs give an opportunity to observe the behaviour of domestic dogs that are free of human intervention (Bradshaw and Wickens, 1992; Clutton-Brock, 1999), allowing a better understanding of domestic dog behaviour in the home or laboratory environment and their basic needs and 'normal' behaviour, as well as similarities and differences in social structure compared to the wolf.

The social grouping of feral dogs is generally considered to be less stable than that of the wolf although some disagreement still exists between authors (Fox et al., 1975; Berman and Dunbar, 1983; Font, 1987; Van Kerkhove, 2004). In one study, rearing of young, hunting and territorial defence were often not carried out by the pack as a whole in feral dogs (Boitani et al., 1995). A number of suggestions have been put forward for the small group size, especially in urban populations with dogs often seen alone or in pairs. Limited food sources and scavenging rather than hunting behaviour have negated the need for a pack to bring down large prey. Font (1987) suggested that in rural areas pack sizes may increase in order to carry out cooperative hunting. However, Daniels (1983) found no effect of food availability on social grouping. The avoidance of humans also appeared to be aided by small pack sizes as dog wardens focused their efforts on large groups of dogs (Fox et al., 1975; Font, 1987). Feral dogs showed greater activity levels at night, probably to reduce encounters with humans (Fox et al., 1975; Boitani et al., 1995).

Feral dogs appear to lack the social structure seen in wolves. Fox (1975) observed no hierarchy and little ritualised social behaviour whilst Berman and Dunbar (1983) found no territorial behaviour or aggression in suburban dogs. In contrast Pal et al. (1998) observed a dominance hierarchy in free ranging dogs with high levels of aggression between females and submission between juveniles. Despite the general acceptance that dogs have a loose social structure, the fact that feral dogs maintain social contact suggests that this remains important for domestic dogs.

1.2.4. Cognition and human signals

Cooper et al. (2003) consider dogs as a good models for the study of cognition, suggesting that dogs are capable of complex cognitive processes. The need to anticipate and understand the actions of group members during cooperative hunting is likely to have led to the development of a high level of cognition in wolves. Although Frank (1980) (cited in Cooper et al., 2003) argues that domestication would have selected against cognition in the dog, via reduced brain size and cranial capacity, experimental evidence does not support this theory. The traditional roles of the dog for hunting and herding and the present day roles as assistance dogs are likely to have been selected for and subsequently exploited the cognitive abilities of the dog to aid in learning new tasks (Cooper et al., 2003). Cooper et al. (2003) also argue that moving into human society has aided the development of relevant cognitive skills. Measuring cognitive abilities is always problematic, since without the presence of language it is difficult to distinguish between cognition and associative learning (Cooper et al., 2003). A number of different experiments have been undertaken which have led to the suggestion of complex cognitive abilities in the dog. However, the knower-guesser task often used in chimp studies found that dogs were more interested in social interaction than the task itself, suggesting that modification of the methodology would be necessary to continue this study in dogs (Ashton and Cooper, unpublished in Cooper et al., 2003).

Domestication has led to the development of a close bond between humans and dogs (Hart, 1995b). When faced with problem solving tasks, the dogs' performance improved when their owner was present even when the owner had no knowledge of the task (Topal et al., 1998). If unable to solve the given task, domestic dogs would look to the human, possibly to receive assistance through signalling (Miklósi et al., 2003). This 'looking' behaviour was not seen in socialised wolves, suggesting that it is the unique communication between dogs and humans that allows dogs to read human signals, a skill likely to have developed as a by product of the domestication process (Miklósi et al., 2003; Reid, 2009). Dogs are also able to use experimenter given cues such as pointing, bowing, nodding, head turning and gazing in order to locate a food reward (Miklósi et al., 1998; Byrne, 2003). Whether these skills are due to enculturation, remnants of wolf ancestry (although socialised wolves failed the task) or domestication (Hare and Tomasello, 2005), they show the presence and capabilities of domestic dogs for reading and responding to human social cues and therefore the likely need of dogs for human contact. The age at which this ability develops continues to be disputed and appears to be dependent on the methodology used, although all the studies appear to show its presence in dogs under 6 months of age (Gácsi et al., 2009; Dorey et al., 2010). Hare et al. (2009), and Reidel et al. (2008), suggest that level of exposure to humans does not affect the ability of juvenile dogs to follow human point cues. Shelter housed dogs also appeared to have a reduced ability to use these cues although their ability improved with experience (Udell et al., 2010).

Dogs also appear to have developed a unique communication mechanism with humans by means of barking. This vocalisation, largely absent in wolves, appears to have developed to allow inter-specific communication though the unique human-dog relationship, with up to 58% of barks being correctly categorised by human listeners (Pongrácz et al., 2005). Domestic dogs also appear to share the capability for a left gaze bias seen in humans and primates, suggesting some degree of face perception (Guo et al., 2009).

1.2.5. Dog Breeds and behavioural differences

Selective breeding over the last 150 years has led to over 400 domestic dog breeds that we have today (Svartberg, 2006). These breeds vary not only in morphology and genetics but also in behaviour (Hart, 1995a; Bradshaw et al., 1996; Ostrander and Wayne, 2005). Studies into behavioural differences between dog breeds focus predominantly on surveys of professionals working regularly with dogs (including small animal veterinarians, dog show judges, dog obedience judges and dog handlers and trainers, animal charity officers and behaviour counsellors) (Hart, 1995a; Bradshaw et al., 1996). Hart (1995a) highlighted some of the problems associated with this approach. Dog show judges were not keen to behaviourally rank dogs, feeling that it would give them a positive or negative value. Dog handlers also posed a problem because their experience was limited to a small number of closely related breeds (Bradshaw et al., 1996). It should also be considered that comparisons of behavioural differences are subjective and reliant on the experience of individuals of different dog breeds. A single bad experience may strongly influence a negative behavioural interpretation towards a particular breed. However, when split into geographical three areas, Bradshaw et al. (1996) found only one significant difference between veterinarians from north east England, those from the south of England and non-veterinarians in the UK, suggesting that individual differences balanced out.

More recently, molecular techniques have been used to distinguish between breeds. These techniques aid in determining the origins of dog breeds and the grouping of breeds to a recent common ancestor (Svartberg, 2006). However, although this allows the formation of a phylogenetic tree of breeds and assists in grouping breeds by relatedness, it does not aid in determining breed specific behavioural characteristics. It appears that at present, the only source of information on breed differences relies on qualitative interpretations by those working with dogs. Svartberg (2005) used behavioural tests to assess breed differences in behaviour for 31 breeds of dog. This study assessed four behavioural traits: playfulness, curiosity/fearlessness, sociability and aggression. A correlation was found between current breed use and breed scores, highlighting the likely affect of recent selection of breeds on behaviour. This method gives an alternative means of assessing breed typical behaviour instead of the use of questionnaires. However, in order to make a reasonable assessment it requires a large number of dogs to be assesses for each breed, an extremely time consuming process.

1.2.6. Needs of specific breeds

No single method to assess breed differences in behaviour has been developed. Despite this, research carried out to date has highlighted that there are differences in breed behaviour and morphology (Reid, 2009) and therefore likely to be breed differences in motivation. The Kennel Club of Great Britain classifies 209 breeds according to 7 breed groups (toy, pastoral, terrier, utility, gundog, working and hound) (Kennel Club, 2006). This classification is based on the historical use of the dog breeds and gives little indication of any similarity in the behaviour of the breeds as grouped. It does however suggest some broad motivations for particular breeds. A Border Collie for example is especially motivated to herd whilst a Labrador Retriever is motivated to retrieve. It is therefore important to look at breeds individually when assessing their enrichment needs, based on their breed-specific behaviour, motivations and intellectual abilities (Overall and Dyer, 2005).

It is clear that artificial selection for specific characteristics has led to vast differences between dog breeds ranging widely in size and conformation (Bradshaw and Brown, 1990). Adult weight can vary from 0.1kg to more than 70kg whilst litter size can be anywhere between one and more than twelve (Fogle, 2007; Jones, 2009). It is well accepted that dogs differ in their biological needs and the diversity of the species has led to a market flooded with foods aimed at meeting the nutritional requirements of different breeds.

Studies into levels of neoteny exhibited by different breeds have highlighted the problems associated with signalling (Goodwin et al., 1997), and certain behavioural traits (and behavioural problems) tend to be associated with particular breeds (Overall and Dyer, 2005). Dogs are utilised for different tasks because of their differences and unique abilities, but despite the acceptance that breeds have very different mental, physical and nutritional needs and abilities, information on behavioural needs and motivations for specific breeds appears to be absent.

1.3. Environmental enrichment of kennelled dogs

1.3.1. Current enrichment for kennelled dogs

Most research into environmental enrichment is focused around zoo animals. Public pressure through perception of the animals' environment drives changes in the way captive animals are presented to the public. Despite the cognitive abilities and human-animal bond developed through evolution and domestication of the dog, studies into environmental enrichment of kennelled dogs are relatively limited. Environmental enrichment for kennelled dogs can be divided into the same areas of animate and inanimate used for other species.

The kennel environment

Kennel environments present a different set of problems and challenges to any other captive environment. The priorities of rescue centre kennels tend to focus around rehoming the dogs and maintaining reasonable welfare standards (Wells and Hepper, 2000). Laboratories aim to produce good quality, repeatable scientific experiments (Prescott et al., 2004). Although the latter implies a need for high welfare, welfare is not considered a priority if it impinges on experimental procedure or makes husbandry difficult. The laboratory environment is relatively controlled and routine whereas a rescue shelter tends to be highly or over stimulating, with random numbers of visitors, dogs constantly arriving and leaving, and many other animals present. In laboratory-housed rhesus monkeys, the environment outside the cage had a greater effect on plasma cortisol (and therefore stress levels) than the provision of environmental enrichment in the cage (Schapiro et al., 1993).

Laboratory dogs show much greater interest in 'toys' than rescue centre dogs do (Wells and Hepper, 1992; Hubrecht, 1993b; Wells, 2004a). Wells (2004b) suggests that this may be due to the high levels of stimulation within the rescue centre environment. It may also be due to the single housing imposed in the majority of rescue dogs compared to the pair or group housing of laboratory dogs, or an altered response to enrichment due to differing initial welfare standards or breed, although the subject has not been investigated further. It does highlight the importance of looking at both types of environment without assuming that optimum enrichment for one is also optimum for the other, and considering the likelihood that dogs in different environments may respond differently to enrichment. Dogs kept in rescue shelters over five years showed significantly lower levels of vocalisation and activity and spent more time at the back of the kennels than dogs housed in the rescue shelter for less than 5 years (Wells et al., 2002b). This study suggests that the kennel environment alters dog behaviour over time (Wells et al., 2002b). Previous experiences of dogs entering rescue shelters have also been found to affect their stress response. Stray dogs and dogs that had previously been in the rescue centre had a better physiological coping mechanism than those new to the environment (Hiby et al., 2006).

A large number of studies have been carried out on the effects of kennel environments on the welfare of domestic dogs (see reviews by Wells, 2004b; Taylor and Mills, 2007), with the main focus upon rescue centre and laboratory housed dogs. Increasing knowledge and understanding of the effects of the kennel environment on the welfare of dogs has led to changes to improve welfare (Taylor and Mills, 2007). However, monetary and practical constraints have limited these changes. Therefore, the opportunity to study and compare dogs housed in higher welfare kennels has to date been limited.

Current information on breeds is limited to traits and subjective assessments. Breed specific enrichment has only been approached in that the majority of studies on laboratory dog enrichment are only carried out on beagles (Hubrecht, 1993b; Siwak-Tapp et al., 2008). Overall and Dyer (2005) recognised the need to provide enrichment based around breed-typical behaviours and intellect, and yet the concept has not been discussed further. Laboratories also tend to focus on (although are not restricted to) group-housed beagles of similar age whilst rescue shelters house a multitude of breeds of varying ages and life experience (Prescott et al., 2004).

Animate enrichment

Animate enrichment encompasses social contact with both conspecifics and with humans (Wells, 2004b). The danger with combining human and conspecific contact in the same category is that they are often grouped together as enrichment techniques (Bayne, 2003). The unique relationship between dogs and humans and the ability of dogs to read human signals has resulted in social contact with humans being very important to domestic dogs (Cooper et al., 2003). However, the idea that human contact is more important than conspecific contact should be approached with caution, since relative importance may be influenced by early experience of the dog. The presentation of scientific evidence to suggest a preference for human contact over conspecific contact does not remove a need for or reduce the importance of conspecific contact. It should not therefore be assumed that the absence of conspecific contact for singly housed dogs could be compensated for by the provision of greater amounts of human contact as suggested in the Home Office Code of Practice (HMSO, 1995). Hubrecht (1993b) suggested that social contact with people was 'more effective' than contact with conspecifics in a laboratory situation since there was no risk of injury to the dog, and cage chewing decreased.

Human contact

Human contact has been shown to improve the welfare of kennelled dogs (Wells, 2004b). When placed in a novel environment, activity and glucocorticoid levels increased in the kennelled dogs, but in the presence of a familiar person in the same environment these increases did not occur (Tuber et al., 1996). On entering rescue centre kennels, socialisation with humans lowered cortisol levels following entry, compared to dogs receiving no extra human contact. However, three days after entering kennels, socialisation with humans had no effect on cortisol levels compared to dogs receiving no extra human contact (Hennessy et al., 1997; Coppola et al., 2006). Coppolla et al. (2006) suggest that human contact aids in reducing stress brought on by entering the kennel environment.

Interactions with humans have also been shown to reduce cortisol elevation following painful and/or stressful procedures (Hennessy et al., 1998). Responses to commands increased, as well as increased levels of relaxed behaviours such as yawning and reduced vocalising following novel situations or painful procedures, although cortisol levels were unaffected (Hennessy et al., 2006). Despite reducing stress hormones and altering behaviour on entering a shelter and following painful and stressful procedures, human contact appears to have no long-term effect on stress hormone levels resulting from kennel housing (Hennessy et al., 1997; Hennessy et al., 1998; Coppola et al., 2006; Hennessy et al., 2006). Lynch and Gantt (1968 cited in Wells, 2004b) found a reduction in heart rate following human handling. However, it was predicted from the behavioural changes observed when a human approached a kennel that heart rate should have increased. Short term stress levels of the dog may also be affected if a person enters the kennel area but does not have any contact with the dog. In one study, the cessation of a human interaction program on shelter dogs did not appear to induce stress behaviours in the dogs. However, this was not the main focus of the study and stress levels may have already been high regardless of the program (Normando et al., 2009).

Although it is clear that human contact can alter the behaviour and physiology of kennelled dogs (Serpell, 1995a), there appears to be minimal focus on the effects of different types of human contact given. Hennessy (1997; 1998) made comparisons between male and female contact and concluded that a preference for female petters was due to subtle differences between the petting given by males and females, rather than differences in non-behavioural cues or previous experiences with other dogs. The effects of contact with familiar (Hubrecht, 1993b) and unfamiliar (Lore and Eisenberg, 1986; Wells and Hepper, 1992) humans have been observed separately; a comparison between the two appears to have been overlooked. Kennelled dogs will often instigate social contact with people (Tuber et al., 1996), but it is unclear whether certain types of human contact are preferred, for example familiar humans for confidence, or unfamiliar for novelty, or a preference for unfamiliar females above familiar males. The need for human contact may also be altered by what the person has been associated with in the past. It is often the case that the dog will not simply receive human contact; in both a rescue centre and laboratory kennel environment the presence of a person may be indicative of food, physical exercise, 'toys' or 'play', grooming or veterinary treatment. Therefore the dog may be more interested in a possible reward associated with human contact than it is with the human contact itself. It is therefore unsurprising that early experiences of human contact will greatly affect the dogs' response to and need for human contact as an adult dog (Serpell, 1995a).

Conspecific contact

Contact with conspecifics can take various forms; continuous contact through group housing; limited social contact through 'play' sessions; visual, auditory and/or olfactory contact. Visual, auditory and olfactory stimulation from other dogs increases the environmental complexity and the amount of time spent at the front of kennels to maintain visual contact (Wells and Hepper, 1998; Wells, 2004b). Wells and Hepper (1998) found no effect of visual contact on vocalisation or activity. Blocking of physical conspecific contact may further increase stress and stereotypic behaviour, by increasing frustration, since the 'motivation to fulfil their inherent desire for social contact' is thwarted (Wells, 2004b). Despite this, in rescue shelters conspecific contact is generally avoided to reduce the risk of disease transmission and aggression related injury (Wells, 2004b). Rescue dogs housed with conspecifics exhibited reduced levels of behavioural problems (11%) and no stereotypic behaviour compared to dogs housed singly (31% and 10% respectively) (Mertens and Umshelm, 1996). Free ranging feral dog populations also form social groups (Boitani et al., 1995). It must therefore be decided whether fulfilling the social needs of a dog is of greater importance than the risk of injury. Visual contact beyond that with humans and conspecifics is limited and the effects of depriving dogs of visual contact unexplored (Taylor and Mills, 2007).

Limited physical contact with conspecifics appears to have been unaddressed in adult dogs, although visual conspecific contact in the absence of physical contact may lead to frustration and elevated levels of barking as a result of over stimulation (Taylor and Mills, 2007). In juveniles (5-9 months), limited conspecific contact in large groups led to the development of skin problems and cage chewing even when the dogs were pair housed for the rest of the period (Hubrecht, 1993b). It is therefore unclear whether a limited amount of physical contact is sufficient to meet the social needs of singly housed dogs or whether frustration behaviour and stress are increased to a point that welfare becomes compromised when the contact is removed or reduced.

Conspecific contact is often confounded with pen size, with singly housed dogs in relatively smaller pens than group housed dogs. Single housing reduced an element of control over the social environment and promoted repetitive and passive behaviour, e.g. because of the smaller pen size, singly housed dogs tended to exhibit circling rather than pacing behaviour (Hubrecht et al., 1992).

Inanimate enrichment

Toys

'Toys' are often provided in a kennel environment as 'play' objects to reduce boredom (Wells, 2004a). However, conflicting results have emerged as to the value of 'toys' to kennel housed dogs. Habituation to 'toys' appears to be common and therefore rotation is necessary to maintain any effect (Wells, 2004b; Wells, 2004a). However, Hubrecht (1993b) observed no habituation over a two month period in beagles under 9 months of age, suggesting that habituation may only be a concern in adult dogs. Hubrecht (1993b) also observed that the presence of 'toys' reduced interactions with conspecifics in order to interact with the toy, proposing that dogs prefer 'toys' to social contact. The 'toys' did not appear to reduce the onset of stereotypic behaviour, although this behaviour accounted for less than 1% of the behavioural time budget measured (Hubrecht, 1993b). Concern has been raised that for group housed dogs, the presence of 'toys' might promote aggression, and although hanging 'toys' on chains stopped any increase in aggression (and also aided in keeping the 'toys' clean), guarding behaviour relating to 'toys' did occur when dogs were able to drag them on to platforms (Hubrecht, 1993b).

Food enrichment

Despite the distinction being made between 'toys' and 'food' enrichment within general environmental enrichment (see section 1.4), for the domestic dog, food and 'toy' enrichment are generally grouped together as 'toys' (Hubrecht, 1993b; Wells, 2004b; Schipper et al., 2008). Food enrichments such as rawhide chews have been provided alongside non-food 'toys' to compare their use in the kennel environment (Hubrecht, 1993b). Wells (2004b) suggests that a preference for a Nylabone (formerly Gumabone) (Nylabone, US) chew is due to a preference for 'toys' that can be chewed rather than a preference for food enrichment above any other form of enrichment. Even though food enrichment may be designed to be chewed rather than ingested, the flavour enhancement used for chews such as Nylabone increases palatability over a chew 'toy'. Although avoiding the use of 'toys impregnated with food', Wells (2004) provided dogs with non-edible

Nylabone chews as a form of 'toy' enrichment even though they are food flavoured such as liver, chicken or bacon (Nylabone, 2009).

Schipper et al. (2008) observed that food stuffed Kongs (Company of Animals, UK) increased foraging behaviour, promoting a very different response to the play behaviour occurring as a result of non-food, 'toy' enrichment (Wells, 2004a). Food enrichment devices such as Nylabone chews, rawhide chews and stuffed Kongs should be grouped separately to non-food 'toys' for comparison since they are capable of providing a completely different type of enrichment, including nutritional and olfactory to a non-food 'toy'.

Kennel furniture

Hubrecht (1993b) found that platforms were well used by the dogs and increased the amount of usable space available to them. However, the study did not detail what could be seen from the platform and therefore left the reason for using the platform open to interpretation. Simply the novelty of a change in visual perspective provided by a new area may be sufficient to increase platform use. However, increased visual contact both with people and conspecifics entering the kennel area may reduce the need for behaviours such as standing on hind legs or barking to maintain contact (Hubrecht, 1993b). It would therefore be interesting to determine how much platforms are used when visual conspecific and human contact can be maintained from the kennel floor.

The introduction of a shelter to the kennel allowed dogs a refuge and an element of choice. However, in the laboratory environment a shelter obstructed daily checks and hindered the formation of any bond with a handler (Hubrecht, 1993b). In the rescue centre environment, provision of a shelter would limit visibility of dogs for potential adopters and therefore reduce rehoming success.

Outdoor access

Spangenberg et al. (2006) argued that dogs should be allowed outdoor access. The increased behavioural repertoire and choice is thought to benefit welfare whilst having no adverse effects on physiology (Spangenberg et al., 2006). Outdoor access also appears to decrease stereotypic behaviour and increase exploratory behaviour (Taylor and Mills, 2007). However, increased outdoor access has been provided in combination with group housing (Hetts et al., 1992;

Hubrecht et al., 1992; Mertens and Umshelm, 1996) or additional space allowance (Spangenberg et al., 2006) making interpretation of the findings more complex.

Auditory enrichment

Noise levels in kennels are considered to be unacceptably high in both laboratory and rescue shelter environments. Noise levels in excess of 100dB are likely to not only affect welfare but may also damage hearing (Milligan et al., 1993; Sales et al., 1997). Although Milligan et al. (1993) raised concerns over the effect of noise levels on behaviour and physiology, there appears to be no research into these effects. Following successful alterations of behaviour and physiology in species such as primates (see Wells, 2004b) and cattle (see Wells, 2004b), auditory enrichment has been suggested as a means of improving welfare, altering behaviour and reducing vocalising in dogs (Wells et al., 2002a). Although classical music increased resting and reduced noise over the study period, two points should be considered. Firstly, the study was only carried out over a four hour period; continual playing of any type of music over a long period of time may eventually be habituated to. Secondly, much of the change in the dogs' behaviour may have been due to effects of the music on the experimenter's or staff's behaviour. A more controlled environment would be needed to look at the effect solely on the dog. However, if the music relaxes the caregivers, any indirect effect on the dog's behaviour may still improve welfare. Consideration should also be given to identifying the reason for any barking. If barking is due to frustration or agitation (Wells, 2004b), reducing levels of barking using music may relax the dog without addressing the underlying reason for the agitation.

Olfactory enrichment

Despite olfaction being considered 'the most important signal modality retained by the dog from the wolf' (Bradshaw and Brown, 1990), olfactory stimulation appears to have received little attention as a form of enrichment until recently. In a rescue shelter environment, lavender and camomile increased resting behaviour whilst rosemary and peppermint increased vocalisation and activity levels in the dogs (Graham et al., 2005a). In pet dogs, lavender was found to reduce activity and vocalisation in dogs suffering from travel induced excitement (Wells, 2006). Despite indicating the potential for essential oils as enrichment and their suggested 'calming effects' on behaviour, neither author (Graham et al., 2005a; Wells, 2006) investigated the effects of aromas more common in the environment of kennelled, domestic or feral dogs. There also appears to be a lack of studies investigating the effects of kennel cleaning on the dogs. This may lead to two distinct problems; firstly, cleaning removes the dog's own scent from the kennel, both reducing familiarity and removing possible social signals in group housed dogs, and secondly, the olfactory acuity of the dog is well known (Graham et al., 2005a) and yet the direct effects of the cleaning agents used in kennels on olfaction appear to have been overlooked.

Dog appeasing pheromone (DAP) is a relatively new drug free method of treating separation related behavioural problems in dogs (Sheppard and Mills, 2003). DAP is naturally produced by lactating females 3 days post-parturition (Pageat and Gaultier, 2003) and when administered artificially as a vapour is thought to calm dogs (Sheppard and Mills, 2003; Ley et al., 2010). Sheppard and Mills (2003) also showed a reduction in fear behaviour in dogs fearful of fireworks when exposed to DAP. Preliminary work in rescue centres has suggested the potential use of DAP as a means of reducing behaviours associated with stress in dogs (Tod et al., 2005). Reductions were observed in barking amplitude and frequency and resting behaviour increased (Tod et al., 2005). This indicates the potential use of DAP to reduce stress behaviours in the kennel environment but also highlights the highly developed olfactory system of the domestic dog.

1.3.2. Measuring enrichment of dogs

Methods to measure environmental enrichment effectively could obstruct the running of rescue centres or laboratory kennels, as discussed earlier. In order to make accurate comparisons between rescue centres and laboratory environments it would be ideal to use techniques that are effective in both situations. Returning to Young's (2006) ideas on the measurement of environmental enrichment, three possible means of measuring enrichment can be investigated. Behavioural observations are a simple non-invasive means of measuring changes pre and post enrichment and consequently are commonly used in enrichment and welfare studies (Young, 2006). Diederich and Giffroy (2006) highlight some of the problems associated with the lack of standardisation in behavioural testing of dogs. First of all, simply the wide range of dogs studied in terms of breed and age introduces possible confounding factors. Second, the behavioural variables measured and the experimental procedures are often decided upon by each experimenter afresh, rather than any standard methodology being adopted (Diederich and Giffroy, 2006). These problems alone make it difficult to make comparisons between studies. Studies by Wells and Hepper (Wells and Hepper, 1992; Wells and Hepper, 1998; Wells, 2004a; Wells, 2004b) tend to concentrate on activity (standing, walking, resting), position in kennel (front, middle or back) and vocalisation. This is somewhat restrictive in what information it provides about the dogs. Measuring all behaviours is, however, time consuming and therefore behaviours considered most relevant are often recorded. Spangenberg et al. (2006) concentrated on activity levels and passive behaviours. If the aim is to reduce abnormal or stereotypic behaviours then it is possible to record these behaviours alone (Mason et al., 2007).

Physiological measures have rarely been used in enrichment studies on dogs. Invasive sampling methods may induce anticipatory stress of the procedure (Beerda et al., 1996). Salivary cortisol has been validated as a non-invasive alternative to plasma cortisol in humans (1996) and have been used when looking at the effectiveness of environmental enrichment in pigs (Koelkebeck and Cain, 1984; De Jong et al., 2000). Cortisol is considered an indicator of stress and therefore could be used as an indicator of welfare. Both salivary and urinary cortisol can be measured without the need for invasive procedures. However, such measurements may be limited for a number of reasons. Firstly, they may be time consuming and generally requires human contact to take samples. This may interfere with the effects of the enrichment devices being assessed. It is also necessary to establish a base level reading before the enrichment is added. Hubrecht (1993b) measured salivary cortisol but found no change following the provision of enrichment despite behavioural changes occurring. Cortisol levels can also increase in relation to factors other than welfare, such as increased activity levels (a possible effect of enrichment itself) (Young, 2006). Urinary cortisol/creatinine ratios have been validated against plasma cortisol to use as a more effective means of measuring stress in dogs (Hiby et al., 2006).

Physiological measures were considered and in some cases attempted in order to complement the behavioural measures of the thesis. Heart rate monitors were piloted at the long-stay enriched (LSE) (Section 8.2.3) but were unsuccessful in maintaining a consistent reading. Heart rate may have provided a physiological measure of stress in order to validate the anticipation and frustration behaviour (Beerda et al., 1998). However, measurements are likely to have been affected by the novelty of the situation and the change in environment. Urinary cortisol would have given a measure of longer term stress but would not have been helpful in determining the short term effects of the enrichment (Stephen and Ledger, 2006). Whilst salivary cortisol offers a short term measure of the stress response in dogs, it is likely that the novelty of the trial, change in location and handling would have confounded the results (Coppola et al., 2006). Sampling of salivary cortisol would have also been difficult to carry out at the RH kennels because the unknown and potentially unpredictable nature of the dogs. Although collection of salivary cortisol was likely to be feasible with the LSE dogs, they also maintained a risk of food contamination (Dreschel and Granger, 2009) due to the continued use of food rewards in the positive reinforcement training throughout the day. Cortisol was not considered a suitable measure and was therefore not pursued in this thesis.

To obtain neurological measures for environmental enrichment, such as those used by Siwak-Tapp et al. (2008), it is often necessary to sacrifice the animal (Young, 2006), or at the very least use invasive techniques, neither of which are appropriate for the laboratory or rescue kennel environment on any scale.

The high turnover of dogs generally seen at rescue centres requires a technique that can be used on large numbers in a short time period. Conversely, laboratories tend to have a fixed number of dogs for a longer, defined period, although these are often limited to beagles (Serpell, 1995a; Wells, 2004b; Luescher and Tyson Medlock, 2008). Techniques must be found that are appropriate to both environments and reach their fullest potential without interfering with other experiments or husbandry procedures. Rescue centre environments may induce acute stress, whereas long-stay dogs in any environment may experience chronic stress, for example via frustration. A given enrichment may consequently affect these two kinds of stress differently (Mason et al., 2007). However, as yet, no single measure has been found to evaluate dog welfare and it is therefore important to use a number of measures when looking at effective assessment of welfare (Hiby et al., 2006).

1.3.3. Other considerations

A number of other effects of enrichment have been overlooked or warrant further consideration, specifically in the case of kennelled dogs. The traditional Pavlovian response of dogs anticipating a food reward through a learned association suggests that dogs are likely to show anticipatory behaviour due to the expectation of receiving enrichment. If that enrichment is subsequently delayed or deprived, frustration behaviour or a stress response may ensue. If this is the case it could be argued that deprivation or delay in expected enrichment may lead to poorer welfare than the lack of any enrichment.

Dogs have been found to habituate to enrichment, particularly 'toys', but at different rates according to the means of enrichment (Wells, 2004b; Wells, 2004a); therefore, their preference for different enrichments may vary over time depending on their level of habituation. Habituation to enrichment is also likely to rapidly diminish the effects of the enrichment and by understanding the motivation behind the enrichment, it may be possible to make minor changes to the enrichment or enrichment programme to reignite the interest in the enrichment.

The provision of different types of enrichment (whether added items or environmental alterations) may also affect preferences for existing enrichments. For example, in juvenile laboratory beagles, the presence of 'toys' as enrichment led to a decrease in conspecific social contact, suggesting that in this case the dogs preferred the toy to social enrichment (Hubrecht, 1993b). However, changes in preference over time and preference between different types of enrichment, such as social contact with humans vs. conspecifics have not been explored systematically.

1.3.4. Summary

It is clear that enrichment is an important means of improving welfare, and that effective techniques are needed to measure enrichment success. Hubrecht (1993b) concluded that if appropriate enrichment is given it can alter behaviour, reduce undesirable behaviours and increase the behavioural repertoire of the dog. Although the last decade has seen an increase in knowledge and implementation of enrichment specifically in the area of kennelled dogs, there continue to be significant gaps in the knowledge of enrichment. If we are to provide the most appropriate environmental enrichment for all kennelled dogs we must first increase our knowledge of their needs.

1.4. Aims of the thesis

The general aim of this thesis is to determine how potential enrichments are utilised by kennel housed dogs, as a possible means of improving welfare. Where possible, broad comparisons between two contrasting kennel environments are incorporated, to aid in determining to what degree interest in enrichment is influenced by environment and how much can be attributed to fulfilling species requirements.

I hypothesise that the extent to which interaction with potential enrichments occurs will be strongly influenced by the kennel environment and the type of enrichment offered. Potential enrichments will be utilised more by dogs housed in the rehoming kennels where structured enrichment programs are not available. Long stay enriched (LSE) dogs will show a greater interest in interact with unfamiliar humans and unfamiliar conspecifics due to the novelty of the interaction in a higher enriched environment.

The two kennel environments used and the broad restrictions placed upon the trials are laid out in Chapter 2. Since toys are considered to have limited value as 'play' objects to many kennel housed dogs (Section 3.1.3), Chapter 3, explores whether varying the presentation method and type of toy presented affects the level of interaction with toys (both for individual toys and total time spent interacting) in the short term. Both human and conspecific contact are considered necessary for kennel housed dogs (Section 3.1.2). In order to determine the likely benefit of familiarity on social contact as a form of enrichment, Chapters 4 and 5, look at the effects of familiarity on preference for human and conspecific contact respectively. Chapter 6 further addresses the effects of enrichment types to determine the choice for different types of enrichment (toys vs. human contact vs. conspecific contact) during short term interactions.

As a means of optimising the longevity of a potential physical enrichment, in Chapter 7 investigates what it is about a manipulable, interactive, 'play' object that leads to habituation and so what can be altered to reinstate play. Alongside this, alterations of time intervals between presentations were studied to observe any interaction with the dishabituation response.

Although the provision of enrichment is seen as a positive step in improving captive animal welfare, it is also recognised that unpredictability and delayed enrichment may have negative effects on welfare (Section 1.5). Therefore, the final study examines the effects of delayed and denied enrichment on behaviour, in order to determine whether behaviours observed during anticipation are the same as those observed during frustration but of a lesser intensity, or whether a qualitative change in behaviour can be observed.

CHAPTER 2: STUDY SITE AND HUSBANDRY ROUTINES

Abstract

Two study sites were used for the trial: the Dogs Trust (Newton Tony, Salisbury), abbreviated to 'rehoming' (RH), and WALTHAM® Centre for Pet Nutrition (WCPN) (Waltham on the Wolds, Leicestershire), abbreviated to 'long stay enriched' (LSE).

The RH dogs had access to an indoor kennel area (1.7m x 1.9m) (facing a corridor and the opposite kennels) and an outdoor covered kennel area (1.7m x 2.7m). Each dog was lead walked for around 20 minutes per day and/or given access to a large concreted compound for a 30 minute period. The LSE dogs had access to an indoor pen (approximately $3.05m^2$) including a raised, heated area (facing a central area and other dog pens), an outdoor covered pen (approximately $4.15m^2$) and an outdoor grass or concrete paddock (29.2-$31.5m^2$). The LSE dogs had a varying daily enrichment schedule.

In both kennel environments, trial dogs were between 1 and 8 years of age (adult). RH dogs were grouped into three size classes by shoulder height when standing: medium (28-44cm), e.g. Terrier; large (45-59cm) e.g. Border Collie; and extra large (>60cm) e.g. German Shepherd. All dogs had been housed on site for at least one week prior to the trial to allow them to acclimatise to the unfamiliar environment, but were otherwise from a wide variety of often unknown backgrounds. Of the LSE dogs, four breeds were suitable and available in sufficient numbers for use on the study; Labrador Retriever, Miniature Schnauzer, Cocker Spaniel and Papillon. All LSE dogs had been born on site or brought in at approximately 9 weeks of age and received the same weekly regime of socialisation and enrichment.

Both the RH and LSE kennels imposed a number of restrictions with regards to their husbandry and the environments the dogs were housed in. These included restrictions on trial times due to husbandry routines, dog availability, enrichments used and areas available to carry out the trial.

2.1. Study sites

Two study sites were used for the trial: the Dogs Trust, Newton Tony, Salisbury and WALTHAM® Centre for Pet Nutrition (WCPN), Waltham on the Wolds, Leicestershire. For the purpose of the study, and in order to characterise the two environments in which the dogs were housed, the Dogs Trust environment was abbreviated to 'rehoming' (RH), whilst the WCPN environment was abbreviated to 'long stay enriched' (LSE).

2.1.1. Rehoming (RH) environment: Housing design

The site was situated in a semi rural location with access to fields and woodlands for walks. While at the centre the dogs were therefore subjected to minimal contact with other dogs and people from outside the centre. The dogs were housed individually or in pairs in line block kennels (Plate 2.1). Forty three kennels were available which accommodated a maximum of 75 dogs at any one time. The dogs had access to an indoor kennel area (1.7m x 1.9m, Plate 2.2a) (facing a corridor and the opposite kennels) and an outdoor covered kennel area (1.7m x 2.7m, Plate 2.2b), allowing visual access to anyone walking past the kennel block. The two areas could be separated using a metal hatch operated using a weighted pulley situated outside of the kennel. This allowed the dogs to be confined to the indoor kennel area at night (between 1600 and 0800). Outside of this time, the dogs had free access to both the indoor and outdoor areas of the kennel, except for the feeding of pair housed dogs, as the dogs were fed separately in the two areas, and during cleaning.

Plate 2.1. Line block kennel housing at the RH environment.

Plate 2.2. Typical (a) indoor and (b) outdoor kennel at the RH environment.

(a) Indoor (b) Outdoor

Daily husbandry and set up

The pens were cleaned thoroughly every day (between 0800 and 0900), at which time the dogs were shut out of the area of the kennel being cleaned, and pens were spot cleaned as necessary throughout the day. The dogs were fed twice a day, at approximately 0800 and 1600. Each dog was lead walked for around 20 minutes per day and/or given access to a large concreted compound for a 30 minute period (8.6m x 15.3m, Plate 2.3). Walks were mainly carried out in woodland and off-road footpaths adjacent to the site. Beyond the daily walks, physical human contact was relatively limited due to the high ratio of dogs to staff members (approximately 12:1; dogs:staff); although the dogs could maintain visual contact with kennel staff throughout much of the day.

Plate 2.3. Concrete exercise compound at the RH environment.

In order to accommodate as many dogs as possible, and to maintain conspecific contact, dogs were, as far as possible, pair housed. Since most of the dogs were relinquished to the centre individually, pair housing was carried out following controlled introductions of two unfamiliar dogs by kennel staff.

Within the kennel, the dogs were provided with beds or blankets in the indoor kennel area and toys were sporadically provided to those dogs that were not considered likely to guard or rapidly destroy them.

2.1.2. Long stay enriched (LSE) environment housing design

The site was situated in a rural location with access to enclosed fields for off-lead exercise and woodlands for walks. The dogs were housed in pairs in pens arranged around an octagonal central court (Loveridge, 1998). The dogs had access to an indoor pen (approximately 3.05m^2, Plate 2.4a) including a raised, heated area (facing a central area and other dog pens), an outdoor covered pen (approximately 4.15m^2, Plate 2.4b) and an outdoor grass or concrete paddock (29.2-31.5m^2, Plate 2.5). The indoor and outdoor pen areas could be sectioned off using a lockable dog flap to allow individual feeding, whilst the outdoor paddock was accessed through a gate from the outdoor pen. This allowed the dogs to be removed from the paddocks and confined to the pen areas at night (between 1600 and 0800). At all times, the dogs had free access to both the indoor and outdoor areas of the pen, except during feeding and cleaning.

Plate 2.4. Typical (a) indoor and (b) outdoor pen at the LSE environment.

(a) Indoor (b) Outdoor

Plate 2.5. Grass and concrete paddock exercise areas at the LSE environment.

Daily husbandry and set up

The pens were cleaned thoroughly once a day, during which time the dogs were shut out of the area being cleaned. Pens were also spot cleaned as necessary throughout the day. The dogs were fed twice a day, at approximately 0800 and 1530. Each dog had a varying daily enrichment schedule. In addition to exercise in paddocks with other dogs throughout the day, each dog received at least one half hour exercise session per day. This varied between a walk with off-lead interaction in an enclosed field, interactive play sessions in paddocks with carers and obedience training sessions. Pet carers (approximately 8:1; dogs:carers) also spent time interacting individually with the dogs in their pens or paddocks on an *ad hoc* basis when time allowed. Soft toys such as teddies were only provided during supervised interaction with the staff due to the risk of destruction and ingestion during unsupervised interaction. The dogs could maintain visual contact with kennel staff throughout the day. All dogs were clicker trained using positive reinforcement, a regime maintained on a daily basis. Dogs were also groomed and had their teeth cleaned every other day. This schedule continued throughout the study period.

Contact with other dogs was restricted to those housed on site to minimise risk of inward disease transmission. Because of this, the dogs were kept within the site and so contact with people was restricted to office and kennel staff and visitors at the centre. Dogs were housed in stable pairs overnight (1600 to 0800). During the day (0800 to 1600) the dogs were housed in "paddock groups", normally consisting of between 3 and 6 dogs.

Overnight, pens were provided with fleece bedding and nylon chews, considered safe for unsupervised interaction. During the day, the dogs had access to large dog toys in the paddocks such as Aussie hanging balls (Aussie dog products, AU), as well as platforms and staging to climb on.

2.2. Study subjects

2.2.1. RH dogs

Dogs were trialled between March 2007 and May 2009. During this period, around 950 dogs passed through the RH kennels. The average length of stay was four to six weeks. However, this included the long-term dogs housed at the centre that were unlikely to be rehomed.

Dogs were relinquished to the centre for a number of reasons. Based on the intake forms over the duration of the study, 44% were handovers from homes, 16% handovers from organisations, 14% were returns, 19% were strays, 4% were transferred from other Dogs Trust centres and 3% were born on site. Although a study across 14 Dogs Trust centres in 2005 found that the two most common reasons for relinquishment from handovers were behaviour problems (55%) and due to the dogs needing more time and attention (22%), the study did not detail return rates, strays, transfers from other centres (Diesel et al., 2010). On arrival at the centre each dog was health checked and neutered if necessary. All adult dogs were neutered before rehoming could take place. Because of the limited history available for most of the dogs and the high percentage of crossbreeds, it was generally not possible to determine the breeding of each dog beyond the breed type dominating its physical appearance. Therefore breed was excluded as a suitable means of categorising the dogs. The dogs were subsequently grouped into three size classes by shoulder height when standing: medium (28-44cm), e.g. Terrier; large (45-59cm) e.g. Border Collie; and extra large (>60cm) e.g. German Shepherd (Appendix 1).

All dogs had been housed on site for at least one week prior to the trial to allow them to acclimatise to the unfamiliar environment, but were otherwise from a wide variety of often unknown backgrounds. Dogs were excluded from the trial if they had recently undergone surgery. For the purpose of the study, only adult dogs were trialled, this included dogs aged between 1 and 8 years either through a known birth date or, if this was not known, when aged by the vet on arrival at the centre.

2.2.2. LSE dogs

Dogs were trialled between April 2007 and July 2009. During this period, up to 157 dogs were housed at the LSE centre at any one time. These consisted of seven breeds; Labrador Retriever, Miniature Schnauzer, Cocker Spaniel, Papillon, Miniature Poodle, Standard Dachshund and Golden Retriever. Ages ranged from 0 to 15 years across the breeds, although the majority of dogs were rehomed when they reached 8 years of age. All dogs had been born on site or brought in at approximately nine weeks of age and, once old they had reached the appropriate age, were neutered unless they were being considered for breeding purposes. The dogs had all received the same regime of socialisation and enrichment. This consisted of a long-term socialisation programme, beginning at the time of the first vaccination (approximately eight weeks of age) and continuing through into adulthood, including socialisation to novel objects, grooming, teeth cleaning, unfamiliar people, and other dogs, all with the aid of positive reinforcement and clicker training.

For the purpose of the study, adult dogs (generally 1 to 8 years) were chosen from those available on site. Since breed comparisons were being made, only four breeds were suitable and available in sufficient numbers for use on the study (and in some cases three); Labrador Retriever, Miniature Schnauzer, Cocker Spaniel and Papillon (Appendix 2).

2.3. Limitations of the two study sites

Both the RH and LSE kennels imposed a number of restrictions with regards to their husbandry routine and the environments the dogs were housed in. Feeding times were fixed and therefore trials had to fit around these times. In both environments, once the afternoon feeding had taken place the dogs were settled for the night and therefore trials had to be completed before this time. This restricted trials to between 0800 and 1530 at RH kennels and between 0915 and 1530 at LSE kennels. At the RH kennels it was also not possible to leave camera equipment set up except during these hours.

A number of site-specific restrictions also arose at the study sites as a result of the way in which the kennels were run and the primary purpose of the kennels, whether as a rehoming centre or a research facility.

2.3.1. RH kennels

Dog availability and history

As these were rehoming kennels, their primary aim was to minimise the amount of time the dogs spent in the kennels and to rehome them as quickly as possible. Because of this, most dogs remained at the centre for around two weeks, with only those dogs with more specific needs taking longer to rehome, and a few long-term and permanent resident dogs.

The relatively short and unpredictable length of time each dog spent at the RH kennels meant that studies were limited to short term trials to avoid losing large numbers of subjects mid-trial or compromising rehoming success. It was generally the case that any dog not reserved at the beginning of any week would be available for the trial for the rest of that week, barring veterinary procedures. Beyond this, availability of individual dogs could not be guaranteed.

Since the majority of dogs were either relinquished by their owners or brought in by the dog warden as strays, the life history of the dogs, in terms of exact breeding, age and past experience was limited. Extra thought was therefore needed during experimental design to avoid using elements that may have increased expectations for some dogs. For example, a Kong (Company of Animals, UK) might not be regarded simply as a 'toy' when it might have in the past been used as a vehicle for food enrichment, eliciting a very different type of response and generating an expectation that an object of this appearance would contain food.

Restrictions on the enrichments used

Human volunteers: Kennel staff were on hand as 'familiar' persons during the trial period. However, their availability was very limited and dependent upon the number of staff working on any one day and the busyness of the kennels. In order to cover the unfamiliar human contact element of the trials, it was necessary to bring volunteers in from off site. The number of available volunteers was limited by the location of the kennels and its distance from the university.

Dogs: The majority of the dogs housed at the RH kennels could be used for the trials that did not require human contact, unless they were known to be particularly destructive or have specific needs. A number of dogs had to be discounted as unsuitable for trials involving human contact as they were not considered to be sociable with unfamiliar persons and could therefore compromise the safety of the person or the welfare of the dog.

Trials requiring dog-dog contact could not be carried out at the RH centre since the short period in which the dogs remained at the kennels and the lack of knowledge of their history and sociability again risked compromising the welfare of the dogs if off-lead interaction was attempted with an unfamiliar dog.

Toys: Very few restrictions were imposed on the use of toys at the RH kennels. Unless a dog was particularly possessive of toys or was considered to be at a high risk of destroying and subsequently ingesting any parts of the toy, then the dog was allowed to participate in the trials.

Trial area

Due to the large numbers of dogs housed at the Dogs Trust at any one time, it was not possible to have a designated test pen for the trial. The majority of trials were therefore restricted to the outdoor area of the dog's home pen. Although reducing continuity in the test area, it did remove the need for acclimatisation and moving the dog to and from a test pen, and other than the outlook of the kennels, the outside areas of the kennels were almost identical. Where a quieter area with fewer distractions was needed, a quiet enclosed barn away from the main kennel block was used (see Section 8.2.1).

2.3.2. LSE kennels

Dog availability and history

As these kennels were primarily a commercial research facility, the dogs remained at the centre from puppyhood until rehoming (generally to staff or friends and family of staff) at around eight years of age. Although this guaranteed the study population, it limited the number and type of dogs available for trials as the turnover was relatively low in the two and a half year period during which the trials were carried out. However, the fact that all the dogs used on the trial were born on site or brought in at approximately 9 weeks of age meant that the life history and breeding was known and socialisation program was consistent for each dog.

Since these dogs were sometimes required for several trials at any one time, it was necessary to reserve dogs up to 3 months in advance. At this time it was necessary to submit the protocol, therefore removing any scope for making alterations to the trial after this point. It also meant that for the most part, dogs were not exclusively available for these specific trials and therefore the experimental design and use of dogs had to take restrictions by other trials by the research company into account.

Restrictions on the enrichments used

Human volunteers: Since volunteers could not be brought on to the site, and it was not possible to use the pet carers due to contractual constraints, volunteers were restricted to office staff who had little or no day to day contact with the dogs.

Dogs: The majority of the dogs could be used for the trials unless they were known to be particularly destructive or possessive with toys or were considered unsuitable for other behavioural reason such as nervousness towards unfamiliar dogs or people.

Toys: Toys used for trials involving unsupervised interaction lasting longer than 30s were required to be relatively indestructible and had to be approved for use by the staff. For very short term interactions (30s or less), it was possible to give the dogs soft, destructible toys. All trials involving the use of toys had to be remotely monitored throughout and the trial immediately ceased if the dog showed any signs of destruction of the toy, removing the risk of ingesting any part of the toy.

Trial area

Trials were carried out in a designated test pen. Although increasing uniformity across the trials, this did require the dogs to be acclimatised to the area prior to each trial. The availability of trial areas also varied throughout the study. When dog numbers on site were low, it was possible to use a designated area away from the main dog population. As numbers increased over the three years, the test area was moved to a room within the dog housing area, providing a greater rate of uncontrollable distractions during the testing periods.

CHAPTER 3: PREFERENCE FOR DIFFERENT TOY TYPES AND PRESENTATIONS IN KENNEL HOUSED DOGS

Pullen, A. et al., 2010. Preferences for toy types and presentations in kennel housed dogs. Applied Animal Behaviour Science. 125 (3-4), 151-156.

Abstract

Toys are often provided as environmental enrichment for adult dogs housed in kennel environments, but their effectiveness as such is not well documented. At a minimum, toys need to excite interest in the animal for which they are intended, before any "enrichment" can be claimed. This study examined short-term interest in, and preferences for toys with a range of characteristics, in both long-stay dogs in complex kennels, and short-stay dogs in rehoming kennels.

The populations, one in residential kennels (LSE, N=30) and the other in rehoming kennels (RH, N=66), were tested with four robust toys, presented both hanging and on the floor, over two 15 minute trials. The trial was also repeated with a second RH population (N=34) replacing the hanging toys with less robust toys. Latency to and duration of interaction with each toy were recorded remotely.

In the first trial, 34% of RH dogs interacted with the toys, compared to 43% of LSE dogs. Floor toys were interacted with for significantly longer than hanging toys by LSE and RH dogs. RH dogs also took less time to first interaction with the floor toys than the hanging toys but there was no difference between latencies to interact with hanging and floor toys by LSE dogs. Of the dogs that interacted, the average duration of interaction was higher for RH dogs (120s) compared to LSE dogs (28s).

In the second trial, 76% of the RH dogs interacted with the toys, interacting for significantly longer with the four less robust toys, but their latencies to interact were similar between the robust and less robust toys. Average duration of interaction (227s) was higher compared to trial 1.

The findings support previous work suggesting that robust toys are little used by kennelled dogs. However, with less robust toys, interaction was relatively prolonged. Hanging toys were not favoured, although these have been reported to stimulate high levels of interaction in juvenile laboratory beagles.

The study suggests that it is important that any toy that is used for "enrichment" should be of interest to the dog, which may be enhanced if the toy makes a noise and can be chewed easily.

3.1. Introduction

Large numbers of adult domestic dogs (*C. familiaris)* are housed in kennels, for a variety of reasons. Despite its long history of domestication (Miklósi, 2008), it is doubtful whether the domestic dog is fully adapted to kennelling, since long-term kennelled dogs may show signs of chronic stress (Beerda et al., 2000). The kennel environment is both spatially and socially restrictive for the dog, and dogs show signs of acute stress when introduced into kennels for the first time (Hiby et al., 2006; Rooney et al., 2007). Furthermore, barren kennels appear to provide little mental or physical stimulation (Wells, 2004b; Taylor and Mills, 2007), and the concept of environmental enrichment is generally promoted as a means of reducing problems caused by confinement in the kennel environment, by increasing normal and/or decreasing abnormal behaviour (Hubrecht, 1993b; Young, 2006).

Environmental enrichment with manipulable objects (hereafter "toys") has been widely investigated, particularly for zoo animals (Shepherdson, 1998), and can be a valuable method for improving welfare if it is effective for the animal and does not simply enhance human perception of the quality of the environment. Hubrecht (1993b) has concluded that if appropriate enrichment is given it can reduce undesirable behaviours and increase the performance of "natural" behaviours, and the provision of enrichment for kennelled domestic dogs may improve both human and canine perception of the quality of the environment (Wells and Hepper, 1992; but see also Luescher and Tyson Medlock, 2008). However, there continue to be gaps in knowledge of how to optimise environments for kennelled dogs, particularly in the long-term (Wells, 2004b).

If the most appropriate environmental enrichment is to be provided for all kennelled dogs, their needs within that environment need to be understood more fully. Research has tended to focus upon juvenile beagles in laboratory housing (Hubrecht et al., 1992; Hubrecht, 1993b) and dogs in rescue and rehoming centres (Wells and Hepper, 1992; Wells et al., 2002b; Wells, 2004a). Although the effects of breed and welfare status have been recognised as important (Overall and Dyer, 2005), these factors have not been examined for their impact on the success of enrichment.

Because of their origins as unwanted or stray animals, and the high turnover of dogs in rehoming centres, the welfare of rescued dogs is often assumed to be of a lower standard than dogs in domestic environments. Rehoming kennels are also novel, highly stimulating and generally stressful for many dogs (Wells and Hepper, 1992; Hennessy et al., 1997; Hiby et al., 2006; Stephen and Ledger, 2006), especially those coming from domestic environments (Hiby et al., 2006). It is therefore likely that such dogs will react very differently to environmental enrichments than dogs which have spent most or all of their lives in kennels. However, no comparison has been made of the enrichment requirements of dogs with different backgrounds or welfare status.

Toys are generally thought of as a practical means of enrichment for kennel housed dogs, as the dog can interact with them either when on its own, or socially, with other dogs and/or people. However, their effectiveness as such is not well documented. Studies by Wells and co-workers (Wells and Hepper, 1992; Wells and Hepper, 2000; Wells, 2004a) in rehoming centres found that toys were more beneficial in increasing rehoming success than for actual interaction and enrichment for the dog, indicating that they were primarily affecting human, rather than canine, perception of the kennel environment. Hubrecht's (1993b) study indicated that hanging chewable toys were useful as enrichment for laboratory beagles, but these stimulated oral behaviour rather than play as such. Laboratory dogs have been found to prefer toys that make a noise or can be chewed (DeLuca and Kranda, 1992; Hubrecht, 1993b; Hubrecht, 1995), although such properties may render the toys easy to destroy, presenting the risk that fragments may be ingested.

At a minimum, toys need to excite interest in the animal for which they are intended, before any "enrichment" can occur. This study examines short-term preferences for toys with a range of characteristics, in both long-stay dogs in complex kennels, and short-stay dogs in rehoming kennels. The two populations were chosen as being substantially different in prior experience of kennelling and enrichment.

Trial 1: Comparisons between robust toys and presentation methods

3.2. Methodology

3.2.1. Study sites

Two study sites were used, rehoming kennels at Dogs Trust, Salisbury (DT) (RH dogs), and residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE). Full details of these are given in Chapter 2.

The RH (rehoming) dogs were housed individually or in pairs in line block kennels. The dogs had access to an indoor kennel area (facing a corridor and the opposite kennels) and an outdoor covered kennel area, allowing visual access to people walking past. The two areas could be separated using a hatch. The trial was carried out in the outdoor area of each dog's home kennel (1.7m x 2.7m, Plate 3.1) (see Chapter 2: housing design for further details). The pens were cleaned thoroughly daily and as necessary throughout the day, and the dogs were walked once daily.

Plate 3.1. Example of outdoor kennel where trials were conducted for the RH dogs.

The LSE (long-stay enriched) dogs were housed in groups in pens arranged around an octagonal central court (Loveridge, 1998). The dogs had access to an indoor pen (facing a central area and other dog pens), an outdoor covered area and an outdoor paddock. The indoor pen area could be sectioned off using a lockable dog flap. The trial was carried out in the indoor area of a pen in an area dedicated to the trial, away from the main housing area (approximately $3.05m^2$, Plate 3.2). The dogs were acclimatised to this pen prior to the trial and the pen was cleaned between each trial. The dogs also had a daily schedule of enrichment and exercise consisting of play sessions, on and off-lead walks and ongoing training sessions.

Plate 3.2. Example of outdoor kennel where trials were conducted for the LSE dogs.

3.2.2. Study subjects

Adult dogs (1-8 years; 60 neutered) were randomly chosen from those housed at the RH kennels at the time of each trial (N=66; 19 female, 47 male).

As the majority of the dogs were of mixed or unknown breeding, they were divided into three size groups by shoulder height: medium (28-44cm), e.g. Terrier (N=16); large (45-59cm) e.g. Border Collie (N=30); and extra large (>60cm) e.g. Siberian Husky (N=20). All dogs had been housed on site for at least one week prior to the trial but were otherwise from a wide variety of often unknown backgrounds, including relinquished by owners and stray.

At the LSE kennels, 30 adult neutered (1-8 years) dogs (16 male, 14 female) were randomly chosen from the four breeds available; Labrador Retriever (N=8), Miniature Schnauzer (N=8), Cocker Spaniel (N=8) and Papillon (N=6). All dogs had been born on site or brought in at approximately 9 weeks of age. The dogs had all received the same regime of socialisation and enrichment.

Dogs were excluded from the trial if they were considered by the kennel staff to be particularly possessive of toys or at high risk of destroying followed by ingesting any parts of the toys (approximately three dogs at the RH kennels and five dogs at the LSE kennels).

3.2.3. Toys

Toys were chosen from those available commercially to dog owners and kennels, avoiding any that might have become associated with food enrichment (e.g. Kongs, flavoured chews). Food related enrichments, including those with a food odour or flavour, were excluded because they are difficult to standardise, and because we chose to focus on visual, tactile and auditory characteristics of enrichment. They were also selected to permit several different types of interaction such as roll, tug and chew.

The toys were selected to be robust and relatively indestructible, to permit unsupervised interaction, and to minimise the risk of damage to the toy and subsequent injury or ingestion by the dog during the two 15 minute trials. They also needed to be suitable for different sizes of dogs.

1. Boomer Ball (The Company of Animals, UK). A virtually indestructible, rollable pursuit toy (Plate 3.3a).
2. Ragger (Petlove, UK). Cotton blend rope tug knotted at both ends (Plate 3.3b).
3. Tug (Kong Company, UK). Durable nylon and rubber flexible tug toy (Plate 3.3c).
4. Tetra Grip (Good Boy, UK). Durable rubber frame toy for retrieving, rolling, tugging and chasing (Plate 3.3d)

Plate 3.3. The four robust toys presented to the dogs during the trial.

3.2.4. Acclimatisation

The LSE dogs were taken to the trial pen during their daily walks for the week preceding the trial, and allowed to get used to being in the pen off-lead. This was continued until the pet carers were satisfied that the dogs were comfortable with the unfamiliar pen. At this point the dogs were not exhibiting signs of distress or nervous behaviours (such as low body posture) and were showing exploratory behaviour and positive interaction with the carer (e.g. play soliciting behaviour). Acclimatisation was not necessary for the RH dogs as they were trialled in their home pens.

3.2.5. Procedure

Trial 1 was divided into two phases of 15 minutes each carried out on consecutive days. In the first phase each dog was presented with all four toys simultaneously, after the dog had entered the kennel, each one either on the floor of the kennel, or hanging from a metal chain across the middle of the kennel at collar height for the dog, according to a randomised incomplete block design (Cochran and Cox, 1957) (Plate 3.4). In the second phase, the dog was exposed to the same toys but in a reverse presentation format i.e. hanging toys in phase 1 were placed on the floor in phase 2 and vice versa (Table 3.1).

Plate 3.4. Example setup of toy combination presented during Trial 1.

Table 3.1. The seven combinations of toys presented to the dogs during Trial 1. Dogs were randomly allocated a dog number and received either phase a. or phase b. for 15 minutes, followed by the remaining phase. For presentation method H=hanging and F=floor.

	phase a.				phase b.			
Dog no.	toy 1	toy 2	toy 3	toy 4	toy 1	toy 2	toy 3	toy 4
dog 1	H ragger	H ball	H tug	F tetra	F ragger	F ball	F tug	H tetra
dog 2	H ragger	H ball	H tetra	F tug	F ragger	F ball	F tetra	H tug
dog 3	H ragger	H tug	H tetra	F ball	F ragger	F tug	F tetra	H ball
dog 4	H ball	H tug	H tetra	F ragger	F ball	F tug	F tetra	H ragger
dog 5	H ragger	H ball	F tug	F tetra	F ragger	F ball	H tug	H tetra
dog 6	H ragger	H tug	F ball	F tetra	F ragger	F tug	H ball	H tetra
dog 7	H ragger	H tetra	F ball	F tug	F ragger	F tetra	H ball	H tug

3.2.6. Data recording

At the RH kennels, interactions with each toy were recorded remotely using camcorders positioned in front of the kennel. At the LSE kennels, cameras were mounted to the ceiling above the test pen since there was no need to move them between trials, as was necessary at the RH kennels.

The videotapes were then analysed using Observer 5.0 (Noldus Information Technology, Nijmegen). Interactions with each of the eight toys were recorded for every dog in order to look at latency to and duration of interaction with each toy. An interaction was defined as anything other than sniffing or accidental contact, so included contact with the mouth or paw, such as mouthing, chewing and pawing at the toy.

3.2.7. Statistical analysis

Statistics were calculated using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. Since none of the data were found to be normally distributed, within group differences were examined using non-parametric tests or, where appropriate non-parametric tests were not available, raw data was replaced by ranks. Wilcoxon tests were used to compare latency to interact and duration of interaction with the toys within the RH and LSE environments. Friedman Chi squared tests were used to compare latency of interaction and duration of interaction between individual toys. Breeds and size classes were compared for the proportion of individuals interacting with toys using Fisher's exact test. A univariate ANOVA was used to compare whether size class affected duration of interaction for ranked data of the toys for the RH dogs.

In a number of cases, the medians included a high proportion of zero values but the statistical test gave a significant result. On these occasions, 3rd quartiles were displayed as well as medians even though the 3rd quartile was not the appropriate summary statistic for the non-parametric statistics used.

3.3. Results: Trial 1

3.3.1. Site and breed differences

When presented with the robust toys, 35% of the RH dogs and 43% of LSE dogs interacted with one or more of the toys over the two presentations. Of the dogs that interacted with toys, the RH dogs interacted for longer than did the LSE dogs (average durations of interaction 120s and 28s respectively).

Amongst the RH dogs, the proportion of dogs that interacted with the toys did not differ between the three size classes (Fisher's exact=0.236). There was also no difference in ranking of the toys by the three size classes by duration of interaction (one way ANOVA F=1.10, df=6, P=0.391).

When divided into their four breeds, the LSE dogs showed a tendency towards some breeds interacting with the toys more than others (Fisher's exact P=0.120). However, since so few of the LSE dogs interacted with the toys (6 Labrador Retrievers, 2 Cocker Spaniels, 4 Miniature Schnauzers and 1 Papillon) it was not possible to look at breed comparisons further.

3.3.2. Comparisons between presentation methods

Excluding dogs that did not interact with the toys at all, the floor toys were interacted with for longer than hanging toys at RH (Wilcoxon Z=2.71, P=0.007) and also at LSE (Z=3.18, P=0.001).

The LSE dogs did not interact with the floor toys any quicker than the hanging toys (Wilcoxon Z=0.94, P=0.35). However, when comparing toys, the tetra, ragger and tug were all interacted with more quickly than the ball (Table 3.2).

Table 3.2. The median and third quartile for latency to interact (s) with the robust toys, by the 13 LSE dogs that interacted with any of the toys. Treatments followed by the same letter were not significantly different at P<0.05 by multiple Wilcoxon tests.

Toy presentation and type		Median	3rd quartile[a]	Dogs interacting (N/13)
Floor tetra	*a*	2.5	23.0	9
Floor ragger	*a*	0.4	6.9	6
Floor tug	*a*	0	9.6	4
Hanging ragger	*ab*	0	0	1
Hanging tug	*ab*	0	0	1
Hanging tetra	*ab*	0	0	1
Hanging ball	*b*	0	0	0
Floor ball	*b*	0	0	0

[a]Third quartiles are included for discrimination between treatments with which less than half of the dogs interacted.

Examining the overall ranking of toys, the RH dogs interacted with hanging toys more quickly than floor toys (Wilcoxon Z=2.94, P=0.003). However, there was no difference between the latencies to interact with the four hanging toys (Friedman Chi squared=3.54, df=3, P=0.32) and only a tendency towards a difference between the four hanging toys (Friedman Chi squared=7.29, df=3, P=0.06), interaction with the floor ball being the quickest, followed by the floor tetra, floor ragger and finally the floor tug.

3.3.3. Comparisons between robust toys

All the floor toys were interacted with for equal durations by the RH dogs (Friedman Chi squared=4.25, df=3, P=0.24). However, for the hanging toys, there was a significant difference in the length of time the toys were interacted with (Friedman Chi squared=15.0, df=3, P=0.002), with the hanging ragger being interacted with more than the other three hanging toys, albeit by a minority of the dogs (Table 3.3). There was no difference in the time spent interacting with the four hanging toys presented to the LSE group (Friedman Chi squared=1.00, df=3, P=0.80) (Table 3.3).

Table 3.3. The median and third quartile duration for duration (s) of interaction with the robust toys, by the 22 RH dogs that interacted with any of the toys in either presentation. Hanging treatments followed by the same letter were not significantly different at P<0.05 by multiple Wilcoxon tests.

Toy presentation and type		Median	3rd quartile[a]	Dogs interacting (N/22)
Hanging ragger	*a*	0	2.4	6
Hanging ball	*b*	0	0	2
Hanging tetra	*b*	0	0	2
Hanging tug	*b*	0	0	1
Floor ragger		0	13.2	10
Floor ball		0	8.7	14
Floor tetra		0	11.8	5
Floor tug		0	0.7	13

The LSE dogs showed a difference in the length of interaction with the four floor toys (Friedman Chi squared=10.1, df=3, P=0.02), interacting with the floor ball for a shorter period than the three other floor toys (Table 3.4).

Table 3.4. The median duration and third quartile for duration (s) of interaction with the robust toys, by the 13 LSE dogs that interacted with any of the toys. Floor treatments followed by the same letter were not significantly different at P<0.05 by multiple Wilcoxon tests.

Toy presentation and type		Median	3rd quartile[a]	Dogs interacting (N/13)
Floor tetra	*a*	4.3	13.6	9
Floor ragger	*a*	3.3	8.2	7
Floor tug	*a*	0	5.9	4
Floor ball	*b*	0	0	0
Hanging tetra		0	0	1
Hanging ragger		0	0	1
Hanging tug		0	5.9	1
Hanging ball		0	0	0

The RH dogs interacted more rapidly with the floor toys than with the hanging toys (Z=2.9, P=0.003) but LSE dogs took the same amount of time to begin interaction with the hanging and floor toys (Z=0.94, P=0.35).

Within each presentation method, there was no difference among the RH dogs between the latencies to interact with the four hanging toys (Friedman Chi squared=3.545, df=3, P>0.05) and only a tendency towards a difference between the four toys when presented on the floor (Friedman Chi squared=7.286, df=3, P=0.063), interaction with the ball being the quickest, followed by the tetra, ragger and slowest with the tug.

3.4. Discussion: Trial 1

The relatively low proportion of dogs that interacted with the toys in both the RH (35%) and LSE (43%) environments supports previous studies by Wells (1992; 2000; 2004a) that toy use in kennels is generally low. This is also supported by the low overall durations of interaction for those dogs that did interact with the toys, both in the RH (28s) and LSE (120s) environments, given that the toys were accessible for 1800s. For the RH dogs, the environment is highly unpredictable, busy and unfamiliar to the dogs. Such a stimulating environment may lead to the toys being of little interest to the dogs by comparison (Wells, 2004a). For the LSE dogs, the environment is much more controlled and familiar but the high levels of daily enrichment may lead to a lack of appeal in the toys since they lack the interest when compared to the other enrichments and interactive 'play' with people and dogs throughout the day. In outdoor-housed pet dogs with high levels of environmental diversity, toy use was also found to be low (Kobelt et al., 2007).

The low levels of interaction with the toys in this trial raises a number of issues about the dog toys used in kennel environments. Requiring toys to be robust, easy to clean and relatively indestructible, may have concomitantly reduced those features that stimulate interactive 'play'. What we as humans have labelled 'toys' may be perceived simply as uninteresting 'objects' to the dogs. It is possible that it is the properties of softness, pliability and potential destructibility that makes some toys appealing for solitary interaction. Laboratory dogs have been found to prefer toys that make noise, can be chewed or are interactive (DeLuca and Kranda, 1992; Hubrecht, 1993b; Hubrecht, 1995; Overall and Dyer, 2005). Therefore, trial 2 was undertaken to establish whether the robustness of the toy affects the amount of interaction the dog has with it.

Trial 2: Comparisons between robust and less toys

3.5. Methodology

3.5.1. Study site

This study was only carried out at the same RH kennels as used in trial 1. LSE dogs were not permitted to have unsupervised interaction for a 15 minute period with toys not considered to be robust, and at high risk of being destroyed and subsequently ingested, and therefore could not be used for this trial.

3.5.2. Study subjects

Adult (1-8 years) dogs (23 male, 11 female) were randomly chosen from those housed at the RH kennels at the time of each trial, N=34 (29 neutered; 11 also used in the first trial and 23 newly recruited). As the majority of the dogs were of mixed or unknown breeding, they were again divided into three size groups by shoulder height as defined in trial 1: medium (28-44cm), e.g. Terrier (N=11); large (45-59cm) e.g. Border Collie (N=16); and extra large (>60cm) e.g. Siberian Husky (N=7). All dogs had been housed on site for at least one week prior to the trial but were otherwise from a wide variety of often unknown backgrounds.

3.5.3. Toys

For the second trial, as well as the four robust toys in trial 1 (tetra grip, ragger, Boomer ball and tug) four additional toys were chosen, again from commercially available toys commonly provided by owners and kennels, but without the restriction that the toys must be indestructible and robust. The individual toys were chosen to stimulate higher levels of interaction by the dogs, from a larger selection of toys piloted at RH kennels.

1. Squeaky bone (Myword, UK). Vinyl bone containing internal high pitched squeaker (Plate 3.5a).
2. Soft teddy (Chubleez, UK). Soft fabric dog shaped toy with an internal squeaker at either end (Plate 3.5b).

3. Plush teddy (Pets at Home, UK). Plush fabric dog shaped toy with an internal squeaker (Plate 3.5c).
4. Tennis ball (Petbase, UK). Soft chenille safari print, non-squeaking small ball (Plate 3.5d).

Plate 3.5. The less robust toys presented to the dogs during the trial.

a.

b.

c.

d.

3.5.4. Procedure

Each dog was presented individually with all eight toys, divided into two blocks of four, in two 15 minute trials, using the same randomised incomplete block design as in trial 1 but replacing the four hanging toys with the four less robust toys (Plate 3.6). Each block contained at least one robust and one non-robust toy. All toys were presented on the floor.

Plate 3.6. Example setup of toy combination presented during Trial 2.

3.5.5. Data recording

Interactions with each toy were recorded remotely using a camcorder positioned in front of the kennel. As with trial 1, an interaction was defined as anything other than sniffing or accidental contact, so included contact with the mouth or paw, such as mouthing, chewing and pawing at the toy.

The data were then analysed using Observer 5.0 (Noldus Information Technology, Nijmegen). Interactions with each of the eight toys were recorded for every dog in order to look at latency to and duration of interaction with each toy.

3.5.6. Statistical analysis

The statistical analysis carried out was the same as in trial 1 (Section 3.2.7).

3.6. Results: Trial 2

3.6.1. Size group differences

There was no significant difference between the three size groups in the proportion of dogs that interacted with the toys (Fisher's exact P=0.13). There was also no difference between the size groups for overall duration of interaction with the toys (Friedman Chi squared=4.41, df=2, P=0.11) or in the ranking of the toys by the three size classes by duration of interaction (one way ANOVA F=0.608, df=12, P=0.834).

3.6.2. Comparisons between toys

In the second trial, undertaken only with RH dogs, 76% of the dogs interacted with one or more of the toys, interacting for longer with the four less robust toys (Z=3.80, P<0.001). The dogs also showed a difference in duration of interaction within the 4 less robust toys (Friedman Chi squared=14.3, df=3, P=0.003). Of the four, the tennis ball was interacted with the least, with no significant difference between length of interaction with the squeaky bone, soft teddy and plush teddy (Table 3.5).

Table 3.5. The median and mean for duration (s) of interaction with the less robust toys, by the 26 RH dogs that interacted with any of the toys. Treatments followed by the same letter were not significantly different at P<0.05 by multiple Wilcoxon tests.

Toy type		Median	Mean	Dogs interacting (N/26)
soft teddy	*a*	13.3	66.1	21
squeaky bone	*a*	5.72	55.8	16
plush teddy	*a*	3.42	49.8	18
tennis ball	*b*	0.74	11.5	14
floor ball		0	4.92	13
floor tetra		0	8.13	10
floor ragger		0	14.9	6
floor tug		0	16.0	4

Within the four robust toys, there was a tendency towards a difference in duration of interaction (Friedman Chi squared=6.75, df=3, P=0.08), which was slightly longer for the tetra grip and ball than for the ragger and tug (Table 3.4).

No difference occurred in the latency of the dogs to interact, comparing the categories of robust and less robust toys (Wilcoxon=0.83, P=0.41).

The soft teddy was interacted with quicker than the tug, ragger and squeaky bone (Friedman Chi Squared=18.0, df=7, P=0.01) (Table 3.6). The dogs showed a similar latency to interact with all other toys.

Table 3.6. The median and mean for latency to interact (s) with the robust and less robust floor toys, by the 26 RH dogs that interacted with any of the toys. Treatments followed by the same letter were not significantly different at P<0.05 by multiple Wilcoxon tests.

Toy type		Median	Mean	Dogs interacting (N/26)
soft teddy	a	25.3	112	21
floor ball	ab	0	82.6	13
tennis ball	ab	4.36	45.9	14
plush teddy	ab	11.2	52.1	18
floor tetra	ab	0	73.0	10
squeaky bone	b	9.64	37.4	16
floor ragger	b	0	50.6	6
floor tug	b	0	39.9	4

3.7. Discussion: Trial 2

3.7.1. Level of interaction

The lack of distinction between length of interaction with the three toys that were readily chewable and squeaked (squeaky bone, soft teddy and plush teddy) confirms DeLuca and Kranda (1992) and Hubrecht's (1993b; 1995) proposal that dogs have a preference for chewable toys that make a noise. However, Wells

(2004a) has suggested that it is more likely to be the fact that toys can be chewed rather than whether or not they squeak that makes them appealing to dogs. Taylor and Mills (2007) suggest toy preference may either be due to a strong motivation to chew or the context in which the toy is presented.

3.8. General discussion

3.8.1. Levels of interaction

The increase in the proportion of dogs interacting with the toys following the introduction of the four less robust toys (76% of dogs interacted in trial 2 compared to 35% of RH dogs in trial 1) clearly indicates that the type of toy presented to the dog has a considerable impact on whether the dog subsequently interacts with the toy, as suggested by Wells (2004a). This is supported further by the increase in the overall length of interaction with the toys (increasing from 120s in trial 1 to 227s in trial 2). The longer duration of interaction with the less robust toys compared to the robust toys further confirms the idea that the dogs show a preference for the less robust toys. When the toys were ranked by duration of interaction, the dogs appeared to show little preference beyond favouring the less robust toys. When laboratory rats were given 'toys' as enrichment objects, they were found to utilise them as objects to gnaw (Belz et al., 2003) suggesting that it is necessary to understand the underlying motivation for interaction with any 'toy' in order to provide those that will be interacted with the most, rather than simply choosing toys that are convenient for caretakers, e.g. are difficult to destroy and easy to keep clean in a kennel environment (Bayne, 2003). Similarly, pigs given enrichment objects interacted more with those that could be chewed, destroyed and ingested suggesting motivations for exploration and foraging (Van de Weerd et al., 2003). The low level of interaction with the floor ball by the RH dogs in the first trial, compared to the other floor toys, supports DeLuca and Kranda's (1992) findings that large polypropylene balls are generally ignored by kennel housed dogs, and suggests a greater interest in toys that can be picked up.

3.8.2. Latency to interact as a measure of preference

The RH dogs showed a preference for floor toys in both duration of interaction, and in their latency to interact. The RH dogs often withdrew from the hanging toys when they began to swing, suggesting that the dogs were not initially keen to explore the toys that may be of a novel, or possibly aversive nature. Although these findings contrast with a study carried out by Hubrecht (1993b), suggesting high levels of interaction with hanging toys, it is worth highlighting that his study was carried out on group housed juvenile laboratory beagles, allowing for interactive 'play' in an environment very different to those studied here. The dogs were also tested with 'food flavoured' Nylabone chews that were likely to encourage interaction due to food motivation. It is also worth noting that Hubrecht (1993b) presented chews a short distance above the floor on springs rather than at collar height on chains, as was used in this study. Although Hubrecht's (1993b) method of presentation may have increased interest in the toys, allowing the dogs to chew them lying down with a paw over the item, this was not considered suitable for unsupervised interaction and in this study toys were hung higher to provide resistance, allowing the dogs to tug against them. The dogs were also able to chew the toys and hold them in their paw when they were presented on the floor, allowing comparisons between types of interaction with the toys.

Despite showing the same preference for floor toys in terms of duration of interaction, the lack of difference in latency to explore the hanging and floor toys by the LSE dogs may be due to a general lack of fear of novelty, as all these dogs had been well socialised to novel objects and situations from an early age, or possibly a generalisation from similar experiences, since they would occasionally have encountered hanging rope toys in their exercise paddocks. Carlstead and Shepherdson (1994) and Shepherdson (1994) support the former idea with the argument that past experiences of novelty and exploration of objects can aid in the development of coping strategies, adaptability, and facilitation of learning in new situations such as those encountered by the dogs when experiencing novel toys.

In both cases this suggests that the initial preference for a toy is not indicative of length of interaction with that toy. The lack of any distinct ranking of the toys in their latency to interact may suggest that the toys were not investigated in any particular order but simply at random, possibly reflecting their position in the kennel, or their degree of familiarity, which would vary from one individual to another.

The lack of discrimination in latency to interact with the toys by RH dogs in the second trial (beyond a preference for the soft teddy) further supports the earlier suggestion from the first trial that not only is it not possible to establish toy preference from the order in which they are interacted with, but that the first interaction with the toys appears to be random if none is considered aversive. The dogs may not know the properties of the toy (such as manipulability or ability to make a noise) until they first interact with it.

3.8.3. Breed differences

The lack of any significant difference in the first trial between breed/size groups in the number of dogs that interacted with the toys, for both the RH and LSE dogs, may indicate that preferences for toys are consistent across breeds. However, it is difficult to draw any real conclusion from this due to the low numbers of dogs interacting in each group. Studies on kennelled dogs in the past have not compared breeds, but the breeding of dogs for differing roles, such as retrieving or guarding, and their division into different groups according to characteristics would suggest that they should prefer different toys (Hart, 1995a; Bradshaw et al., 1996). General observations at the RH environment suggested that the 'Staffordshire bull terrier' type dogs showed a preference for the hanging ragger as it allowed for interactive 'tugging'.

In the second trial, as with the first trial, it is unclear whether the lack of size differences seen in both levels of interaction and preferences for toys were due to the dogs all favouring the same toys, or, because the groupings had been created by size rather than genetics, breeds of the same type (e.g. gundogs) could have appeared in more than one group.

3.9. Conclusion

It is clear that the environment that the dog is recruited from can affect the effectiveness of toys as enrichment. However, what appears to be of greater importance, in terms of initial level of interaction, is the means of presentation (hanging and floor) and the type of toy provided. The two populations of dogs studied both showed strong preferences for toys placed on the floor of the kennel, as opposed to hanging. In addition to this, the RH dogs, trialled with robust and less robust toys, showed a preference for softer, more manipulable toys. It appears that some compromise may be needed between enrichment and safety, since the toys preferred by the dogs appear to be those that are most difficult to keep clean and pose highest risk of destruction and ingestion. Although preference for particular toys appears to be little affected by breed and size of dog, prior experience may affect individual preferences; the most confident dogs may be initially attracted to novel toys, while those that are more generally fearful or anxious may react neophobically to unfamiliar toys and/or modes of presentation. Further studies will be required to determine whether the initial preferences demonstrated here are sustained over more prolonged presentation of the toys, and which toys, if any, provide sustained "enrichment" beyond their value in temporarily increasing environmental complexity. Interaction with toys may be further altered by availability of more attractive toys presented outside of the artificial kennel environment. However, it may be that for dogs housed in an enriched and complex environment, such as the LSE dogs, there may be little need or value in providing extra enrichment.

CHAPTER 4: THE EFFECT OF FAMILIARITY ON BEHAVIOUR OF KENNEL HOUSED DOGS DURING INTERACTIONS WITH HUMANS

Abstract

Human contact is thought to positively alter kennelled dog welfare. Although most dogs often instigate social contact with people, it is unclear what type of human contact they prefer. This study assessed the effect of familiarity of the human on interaction by kennelled dogs.

Two populations were studied: dogs in rehoming (RH) kennels (N=25; three breed size groups) entering the kennel as adults; dogs in long stay enriched (LSE) kennels (N=23; three breeds), born on site or brought in at approximately 9 weeks old.

Volunteers (classed as unfamiliar or familiar to each dog) entered the pen and sat for 10 minutes. For the LSE dogs, familiarity was built up over 3 days (F1, F2 and F3) allowing a further comparison of familiarity when the person was the same. If the dog was 'next to' (within arms' reach) the volunteer petted and spoke to the dog, but otherwise the dog was ignored. The two most behaviourally distinct time periods, 0-2 min and 8-10 min, were analysed.

RH dogs spent longer 'next to, facing' (within arms reach and orientated towards the person) familiar (F) than unfamiliar (UF) people at 0-2 min whilst showing a tendency towards spending longer 'next to, away' (within arms reach and orientated away from the person) from unfamiliar (UF) than familiar (F) people at 0-2min. No differences between breed/size groups were detected.

Comparing UF with F people (3rd day of interaction; F3), the LSE dogs showed no significant difference in time spent at any of the distance categories. However, when comparing the first with the third session of interaction with the same person (UF becoming familiar), LSE dogs spent more time 'next to, facing' them at 0-2 min when unfamiliar (F1) than when familiar (F3), whilst spending longer 'far away' from them when familiar (F3) than when unfamiliar (F1) at 8-10min. Breed differences were only evident at 8-10 min and when the person was familiar.

The behaviour of the RH dogs suggested that they valued familiar and unfamiliar contact equally, but with unfamiliar people were more alert to their surroundings. LSE dogs appeared to prefer unfamiliar people, perhaps because the dogs receive high daily levels of human contact.

Overall, preference for familiar vs. unfamiliar human contact appeared to be affected more by environment and past experience than breed. Therefore, the welfare benefit of different forms of human contact is likely to differ between facilities.

4.1. Introduction

The close bond that has formed between humans and domestic dogs, resulting from domestication, has increased their ability to read and respond to human-given cues (Hare et al., 2002; Miklósi, 2008; Hare et al., 2009). However, it has also led to a 'need' for human contact by domestic dogs and arguably a greater requirement for human than conspecific contact in maintaining welfare (Wells, 2004b). Human contact is also considered advantageous over conspecific contact as it reduces the risk of injury to the dogs during interactions (Hubrecht, 1993b).

Human contact has been shown to alter the behaviour and physiology of kennelled dogs (Serpell, 1995a). Reductions in dogs' cortisol levels have occurred following petting sessions (Coppola et al., 2006) and grooming whilst handling has led to a moderation of HPA axis activity in shelter dogs (Hennessy et al., 2002).

Long-term modification of behaviour has also been observed in both shelter dogs and laboratory dogs as a result of human contact. Increased visual contact with humans led to increased activity in shelter dogs (Wells and Hepper, 2000) and basic training and play sessions improved their docility, obedience and sociability (Valsecchi et al., 2007). An increase in the handling of laboratory beagles reduced chewing of cage furniture and increased approachability towards humans (Hubrecht, 1993b; Hubrecht, 1995).

Although there is agreement in the literature as to the importance of human contact as a form of enrichment to kennel housed dogs, there appears to have been little research focusing on the relative efficacy of different types of human contact given.

Within the kennel environment, the effect of human contact on behavioural change in the dog has often focused on reducing or halting undesirable behaviours (such as reducing stereotypic behaviour, increasing time at the front of the kennel) to increase rehoming success, rather than assessing and improving welfare of the dogs whilst in the kennel environment (Wells, 2004b; Normando et al., 2009).

The effects of contact with familiar (Tuber et al., 1996) and unfamiliar (Lore and Eisenberg, 1986; Hennessy et al., 1997) humans (without the inclusion of play) have been observed separately, but comparisons between the two appear to have been largely overlooked. Head et al.'s (1997) study observed that both laboratory housed beagles and mixed breed shelter dogs remained in the area near to the person during an open field test. No effect of familiarity was observed, beyond an increased level of individual variation between dogs when with the unfamiliar human. During play sessions, Toth et al. (2008) found that dogs did not distinguish between familiar and unfamiliar human play partners, contrasting with Mitchell and Thompson's (1990) findings that familiarity of humans affected play partner choice. Wells (1992) observed that dogs housed in rescue centres reduced their level of reactivity to an unfamiliar person looking into their cage over five consecutive days (possibly a result of increasing familiarity or reduced novelty). Kennelled dogs will often instigate social contact with people (Hubrecht, 1993b; Tuber et al., 1996), but it is unclear whether certain types of human contact are preferred; for example familiar humans for reassurance, or unfamiliar for novelty.

The gender of the person providing the human contact has also been found, in some instances, to affect both the behavioural and physiological response of the dog. Male shelter dogs were more likely to approach unfamiliar women than unfamiliar men, although female dogs showed no preference (Lore and Eisenberg, 1986). Shelter dogs also showed more defensive aggressive behaviour (barking and maintaining eye contact) to the presence of unfamiliar men than unfamiliar women outside their kennel (Wells and Hepper, 1999). Interaction sessions with an unfamiliar woman induced a lower cortisol level in shelter dogs than with an unfamiliar man (Hennessy, 1997), although when the method of petting was more controlled, cortisol differences resulting from male and female petters were limited (Hennessy et al., 1998).

The study reported here compares the effect of familiar and unfamiliar human contact on the level and quality of interaction exhibited by kennelled dogs from two populations. It also investigates the effect of breed of dog and gender of the human volunteer on the behaviour of the dogs.

4.2. Methodology

4.2.1. Study sites

As with the 'preferences for different toy types and presentations in kennel housed dogs' study (Chapter 3), this trial was also undertaken at the rehoming kennels at Dogs Trust, Salisbury (DT) (RH dogs), and residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE). During this trial, the set up and husbandry routines carried out at the two sites were the same as during the 'toy types' trial (Chapter 3). More general background information on the study sites, husbandry routines and study subjects is given in Chapter 2.

At the RH kennels, the trial was carried out in the outdoor area of each dog's home kennel. For the LSE dogs, the trial was undertaken in the indoor area of a pen in an area dedicated to the trial, away from the main housing area. The dogs were habituated to this pen prior to the trial and the pen was cleaned between each trial.

4.2.2. Study subjects

Twenty five adult (1-8 years; 22 neutered) RH dogs (13 male, 12 female) in 3 breed size groups; medium (N=6), large (N=13) and extra large (N=6) (see Chapter 3 methodology for size grouping criteria) were randomly chosen from those housed at the RH kennels at the time of the trial. All dogs had been housed on site for at least one week prior to the trial but were otherwise from a wide variety of often unknown backgrounds, including relinquishment by owners and strays. Four dogs had been used on the 'toys trial' (Chapter 3), whilst 21 dogs had not previously been used for any studies reported here.

Twenty eight adult neutered (1-8 years) LSE dogs (15 male, 13 female) were randomly chosen from the four breeds available; Labrador Retriever (LR) (N=7), Miniature Schnauzer (MS) (N=8), Cocker Spaniel (CS) (N=8) and Papillon (P) (N=5). All dogs had been born on the site or brought in at approximately 9 weeks of age. The dogs had all received the same regime of socialisation and enrichment. Twenty four dogs had been used on the 'toys trial' (Chapter 3), whilst four dogs had not previously been used for any studies reported here.

RH dogs were excluded from the trial if they were considered by the kennel staff to be fearful or aggressive of unfamiliar people (approximately 40% of RH dogs). No LSE dogs were excluded from the trial.

4.2.3. Acclimatisation

Acclimatisation was not necessary for the RH dogs as they were trialled in their home pens. Acclimatisation for the LSE dogs was incorporated into their daily walks for the week preceding the trial; the dogs were taken to the trial pen and allowed to get used to being in the pen off-lead. This was continued until the pet carers were satisfied that the dogs were comfortable with the unfamiliar pen. At this point the dogs were not exhibiting signs of distress or nervous behaviours (such as low body posture) and were showing exploratory behaviour and positive interaction with the carer (e.g. play soliciting behaviour).

4.2.4. Procedure

One of the volunteers entered the pen and sat on the floor or chair (depending on the size of the dog) away from the dog flap or front of the kennel, with their back to the wall for a 15 minute period (this was reduced to 10 minutes for the RH dogs due to volunteer time constraints). If the dog approached within arms' reach, they interacted with the dog (petted and/or talked to the dog). If the dog moved out of arms' reach they ignored the dog (including eye contact) (Plate 4.1). Each dog was tested with one unfamiliar person and one familiar person. For the RH dogs, the nine familiar people (two male, seven female) were kennel staff (aged 20-45) whilst the four unfamiliar people (two male, two female) were offsite volunteers (aged 20-35). The number of RH dogs tested with each person was determined by the availability of volunteers on the days that the dogs needed to be trialled.

Plate 4.1. Interaction between familiar person and LSE trial dog.

The 16 volunteers at WCPN were office staff (seven male, nine female volunteers; aged 25-45) who had minimal contact with the dogs. They tested two dogs as a familiar person (F) and two as an unfamiliar person (UF). Familiarity was built up over three consecutive days of 10 minute trials with the dog as this was considered a sufficient length of time for an individual to become familiar to a dog (Gácsi et al., 2001; Hill, 2007). This also allowed for further comparison of familiarity between day 1 of interaction (F1), when the person was unfamiliar to the dog and day 3 (F3) when that same person had become familiar, which was also compared to when the dog was trialled with a different, unfamiliar person altogether (UF).

4.2.5. Data recording

At the RH kennels, interactions with the person were recorded remotely using camcorders positioned in front of the kennel. At the LSE kennels, cameras were mounted to the ceiling above the test pen since there was no need to move them between trials, as was necessary at the RH kennels.

The data were then analysed using Observer 5.0 (Noldus Information Technology, Nijmegen). Interactions with the familiar and unfamiliar person were recorded for each dog in order to look at latency to and duration of interaction with the person, in terms of position in the kennel (in contact, near, middle and far) (Plate 4.2) and orientation of the dog (towards or away from the person) (Table 4.1).

Plate 4.2. A typical kennel used for the trial at (a) LSE and (b) RH kennels. Shading defines the approximate areas used for 'near', 'middle' and 'far' positions in the kennel.

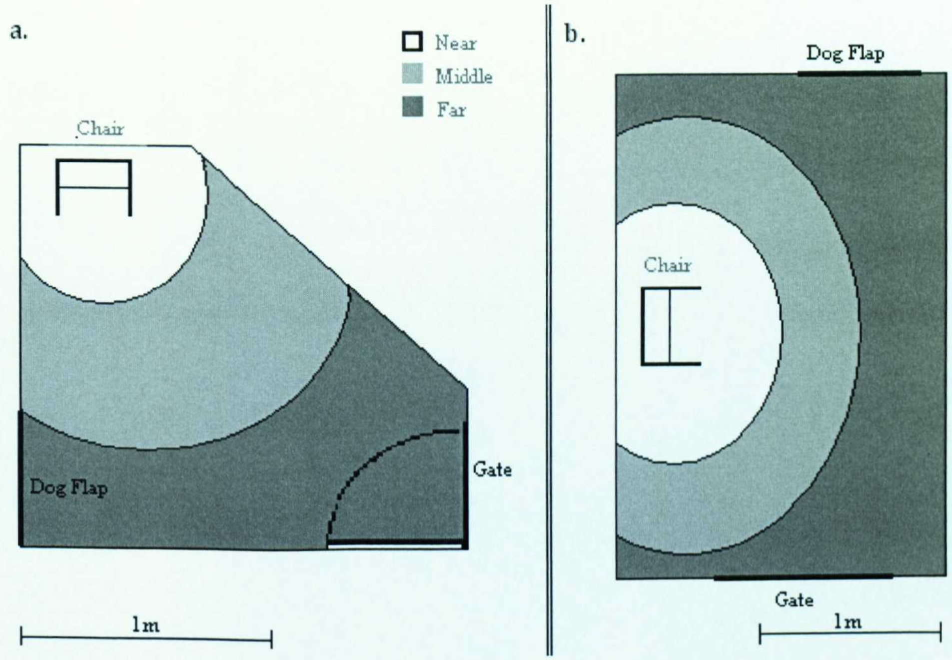


Table 4.1. Initial behavioural categories during interaction with familiar and unfamiliar humans. Areas are defined as those in Plate 4.2. of the test pen divisions.

Behavioural Category	Description
In contact facing	Dog has its head within near section, in physical contact with the person and is orientated towards the person
In contact away	Dog has its head within near section, in physical contact with the person and is orientated away from the person
Near facing	Dog has its head within 'near' section (within arms reach of the person) but is not in physical contact with the person and is orientated towards the person
Near away	Dog has its head within 'near' section (within arms reach of the person) but is not in physical contact with the person and is orientated away from the person
Middle facing	Dog has its head within middle section and is orientated towards the person
Middle away	Dog has its head within middle section and is orientated away from the person
Far facing	Dog has its head within far section and is orientated towards the person
Far away	Dog has its head within far section and is orientated away from the person

4.2.6. Statistical analysis

Statistics were calculated using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. Since none of the data were found to be normally distributed, hypotheses were examined using non-parametric tests.

4.2.6.1. Preliminary analysis

Spearman's rank correlations were carried out on the duration of interaction data for two dogs randomly chosen from each breed or breed group to determine whether analysis was necessary for the whole time period for each interaction, or whether, when split into three and two minute time periods (RH and LSE dogs respectively) to allow both the 10 minute trial period for the RH dogs and 15 minute trial period for the LSE dogs to be divided into equal subsamples for further analysis.

4.2.6.2. Hypothesis testing

For both the RH and LSE environments, Wilcoxon tests were used to compare duration of each behavioural category for familiar vs. unfamiliar people. Overall breed differences were compared using a Kruskal-Wallis test, followed by Mann-Whitney U tests to compare two breeds in the case of a significant result from the Kruskal-Wallis test. The Papillons were excluded from breed analysis due to their low numbers (N=5). At the LSE kennels, the effect of gender of the human in both the familiar and unfamiliar situations was compared using Mann-Whitney U tests.

In a number of cases, medians were identical or very close but the statistical test gave a significant result. On these occasions, means are displayed as well as medians even though the mean is not the appropriate summary statistic for the non-parametric statistics used.

4.3. Results

4.3.1. Preliminary analysis

Following the division of the RH observations into five two minute time periods, the distance of the focal dog from the person was found to be highly correlated for all time periods except 0-2 min during preliminary analysis for a random sample of eight dogs of the RH dogs. This was the case when looking at familiar and unfamiliar interactions separately and combined (Appendix 3). This trend was also present in the data for a random sample of eight LSE dogs with weaker or no correlations occurring between 0-3 min and all other time periods, whilst stronger correlations were present between 3-6 min, 6-9 min, 9-12 min and 12-15 min for familiar and unfamiliar interactions separately and combined (Appendix 4).

Analysis was therefore carried out on the two time periods which the preliminary analysis suggested were most behaviourally distinct and allowed for comparisons between the two kennel environments. Thus 0-2 min was analysed (0-3 min in the case of the LSE dogs) and 8-10 min (9-12 min for the LSE dogs). The second time period gave an overview of the behaviour in the later part of the trial period whilst giving the greatest overlap of the time intervals used for RH and LSE dogs.

4.3.2. Behavioural categories

'Middle facing', 'middle away' and 'far facing' accounted for less than 10% of the durations in each of the time periods; they appeared to be transitory states and were therefore not analysed further. 'next to facing' and 'in contact facing' were combined to create 'near facing' (this was also the case for 'near away', combining 'next to away' and 'in contact away') since 'in contact' could have been determined by the person rather than the dog. This resulted in three behaviourally distinct categories for further analysis (Table 4.2; Table 4.3).

Table 4.2. Revised behavioural categories for further analysis. Areas are defined as those in Plate 4.2. of the test pen divisions.

Behavioural Category	Description
Next to facing	Dog has its head within 'near' section (within arms reach of the person) and is orientated towards the person
Next to away	Dog has its head within 'near' section (within arms reach of the person) and is orientated away from the person
Far away	Dog has its head within section far and is orientated away from the person

Table 4.3. Overall percentage of time spent in each behavioural category by the (a) RH (N=25) and (b) LSE (N=28) dogs. Average values were taken for all dog/people combinations

(a) RH dogs

Behavioural category	Time period	% of time interval
Next to facing	0-2min	44.3
	8-10min	19.7
Next to away	0-2min	32.2
	8-10min	38.5
Far away	0-2min	8.3
	8-10min	25.7

(b) LSE dogs

Behavioural category	Time period	% of time interval
Next to facing	0-3min	39.0
	9-12min	20.4
Next to away	0-3min	42.9
	9-12min	53.2
Far away	0-3min	13.2
	9-12min	20.2

4.3.3. Familiarity of human

RH dogs spent more time 'next to facing' familiar (F) people than unfamiliar (UF) at 0-2 min (Wilcoxon Z=2.35, P=0.02) whilst showing a tendency towards spending more time 'next to away' unfamiliar (UF) people in the same time period (Z=1.84, P=0.06). RH dogs spent equal amounts of time 'far away' from F and UF people at 0-2 min (Z=1.64, P=0.10) (Table 4.4, Table 4.5, Figure 4.1a).

At 8-10 min, no differences were observed in the amount of time spent at any of the behavioural categories when comparing the F and UF interactions (Table 4.4, Table 4.5, Figure 4.1b).

Table 4.4. The Z statistic and P value from multiple Wilcoxon tests for familiarity of human comparisons at 0-2 min and 8-10 min by the 25 RH focal dogs. P values followed by * were significantly different at $P<0.05$.

Behavioural category	Time period	Familiar vs. Unfamiliar (F vs. UF)
Next to facing	0-2min	2.35, 0.02*
	8-10min	1.31, 0.19
Next to away	0-2min	1.84, 0.06
	8-10min	1.52, 0.13
Far away	0-2min	1.64, 0.10
	8-10min	0.58, 0.56

Table 4.5. The median and mean durations of interaction (s) for familiarity of human comparisons at 0-2 min and 8-10 min, by the 25 RH focal dogs. Treatments in bold on the same row were significantly different at P<0.05 by multiple Wilcoxon tests.

Time period	Behavioural category	Familiar		Unfamiliar	
		Median	Mean	Median	Mean
0-2 min	next to facing	**46.2**	50.5	**46.2**	40.3
	next to away	18.7	23.2	28.2	34.0
	far away	3.80	6.43	5.52	11.1
8-10min	next to facing	8.00	23.0	5.45	16.3
	next to away	21.0	29.2	36.3	41.2
	far away	15.7	30.8	8.24	22.8

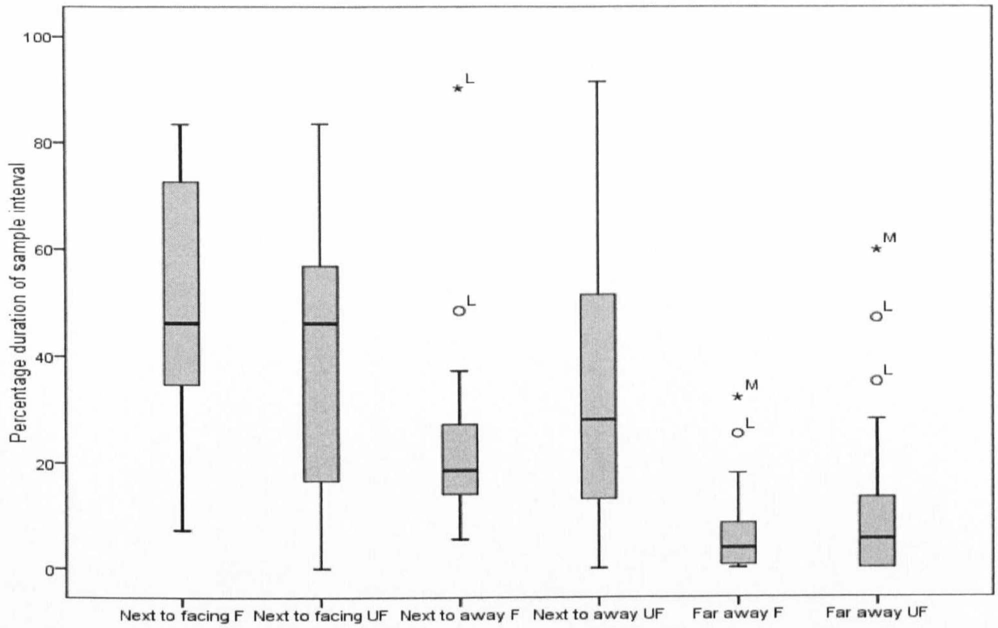


Figure 4.1a. 0-2min

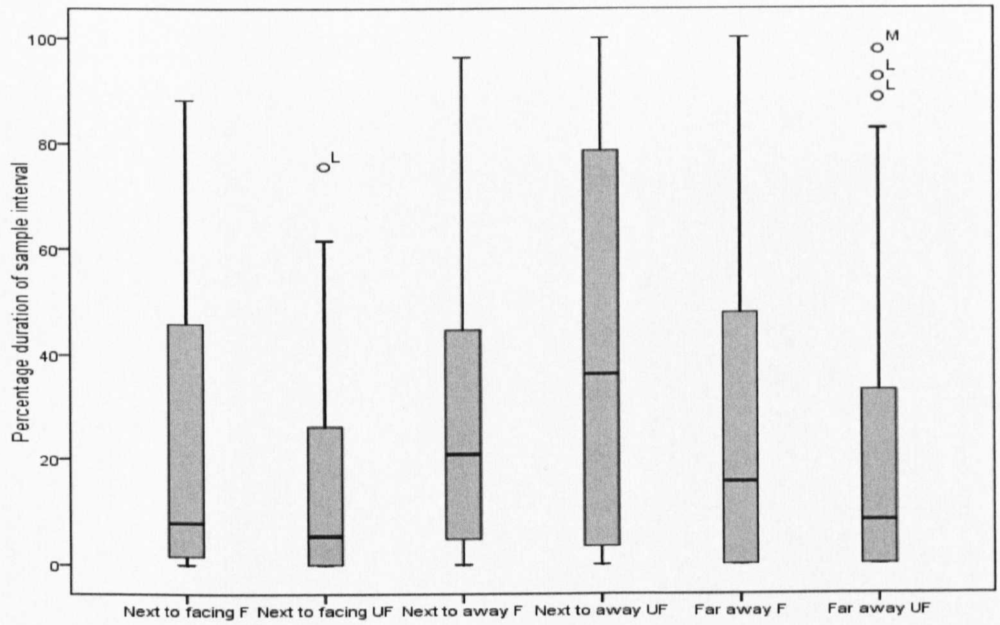


Figure 4.1b. 8-10 min

Figure 4.1. Boxplots of duration (%) in each of the behavioural categories when the person was unfamiliar (UF) and familiar (F), at 0-2 min (Figure 4.1a) and 8-10 min (Figure 4.1b), by the 25 RH dogs. The box indicates the extent of the 25th and 75th percentiles, central line is the median and whiskers indicate minimum and maximum values (apart from outliers which are single data points more than 1.5 box-heights from the box). Outliers are classified by breed size group: M=medium, L=large, XL=extra large.

Comparing the unfamiliar (UF) and familiar (F3) interactions, the LSE dogs showed no significant difference in time spent at any of the distance categories (Table 4.6, Table 4.7, Figure 4.2).

However, when comparing F1 and F3 observations (the effect of familiarity when the volunteer was the same for both interactions) LSE dogs spent more time 'next to facing' the person when unfamiliar than when familiar, at 0-3 min (Z=2.35, P=0.02), whilst spending the same amount of time 'next to away' (Z=1.80, P=0.07) and 'far away' (Z=0.958, P=0.34) (Table 4.6, Table 4.7, Figure 4.3).

At 9-12 min the dogs spent more time 'far away' from the person once they had become familiar than when they had been unfamiliar (Z=2.20, P=0.03), whilst spending the same amount of time 'next to facing' (Z=1.42, P=0.42) and 'next to away' (Z=1.64, P=0.10) both the familiar and initially unfamiliar (F1) person (Table 4.6, Table 4.7, Figure 4.4).

These differences between the UF vs. F3 and F1 vs. F3 comparisons were unexpected, since both compared unfamiliar with familiar. In case the two categories had been different by chance at baseline, the unfamiliar (UF) and familiar day 1 (F1) were compared (identical treatments but with different volunteers in each category): the LSE dogs showed no significant differences in their time spent at any of the distance categories (Table 4.6).

Table 4.6. The Z statistic and P value from multiple Wilcoxon tests for familiarity of human comparisons at 0-3 min and 9-12 min for comparisons between F3 and UF, between F3 and F1 and between F1 and UF by the 28 LSE focal dogs. P values followed by * were significantly different at $P<0.05$.

Behavioural category	Time period	Familiar (F3) vs. Unfamiliar (UF)	Familiar (F3) vs. Unfamiliar (F1)	Unfamiliar (UF) vs. Unfamiliar (F1)
Next to facing	0-3min	1.18, 0.24	2.34, 0.02*	0.911, 0.36
	9-12min	1.27, 0.20	1.42, 0.16	0.046, 0.96
Next to away	0-3min	0.865, 0.39	1.80, 0.07	0.410, 0.68
	9-12min	0.144, 0.89	1.64, 0.10	1.58, 0.11
Far away	0-3min	0.226, 0.82	0.958, 0.34	0.282, 0.78
	9-12min	1.21, 0.23	2.20, 0.03*	1.45, 0.15

Table 4.7. The median and mean duration of interaction (s) within the 3 behavioural categories for familiarity of human comparisons at 0-3 min and 9-12 min by the 28 LSE focal dogs. Treatments in bold on the same row were significantly different at P<0.05 by multiple Wilcoxon tests.

Time period	Behavioural category	Unfamiliar (F1)		Familiar (F3)		Unfamiliar (UF)	
		Median	Mean	Median	Mean	Median	Mean
0-3min	next to face	**41.7**	42.7	**29.7**	33.7	34.9	38.4
	next to away	35.7	40.0	55.6	48.6	33.2	42.0
	far away	0.7	11.0	3.9	13.0	1.1	12.2
9-12min	next to face	16.6	21.1	14.4	15.1	13.9	21.3
	next to away	63.2	61.3	57.7	48.9	40.1	50.3
	far away	**0.3**	12.6	**7.0**	29.8	10.4	20.7

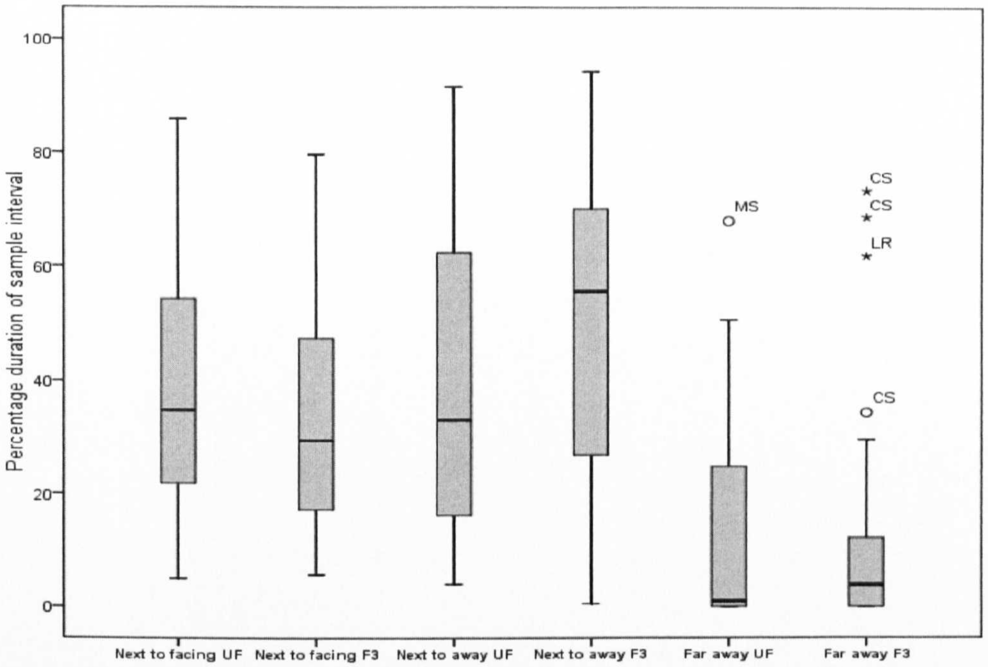


Figure 4.2a. 0-3min

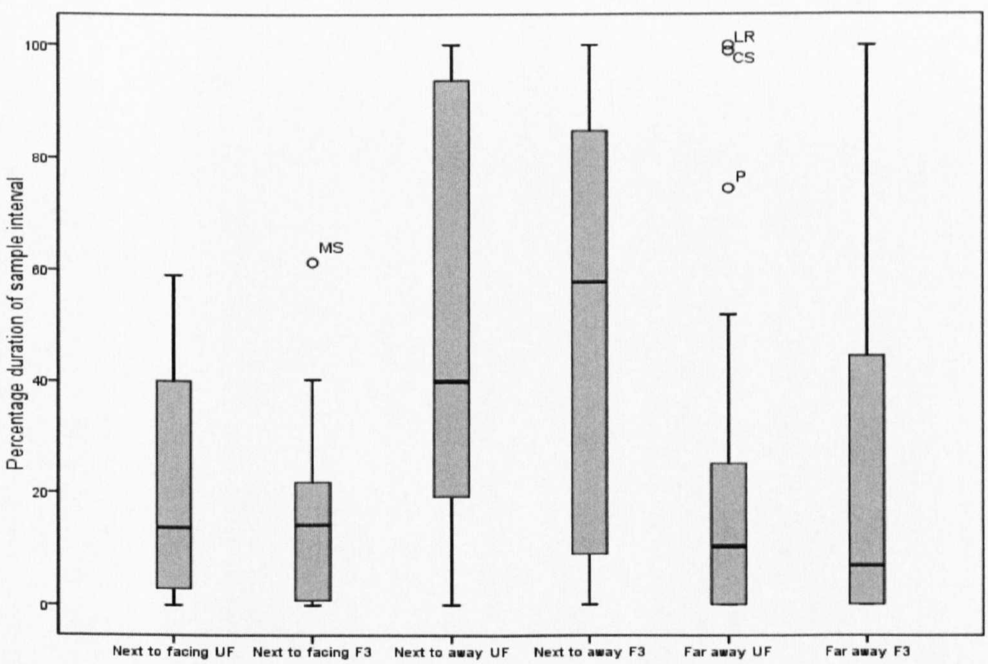


Figure 4.2b. 9-12min

Figure 4.2. Boxplots of duration (%) in each of the behavioural categories when the person was unfamiliar (UF) and familiar (F3) at 0-3 min (Figure 4.2a) and 9-12 min (Figure 4.2b), by the 28 LSE dogs. Outliers are classified by breed group: LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel, P=Papillon. See Figure 4.1 for description of boxplot characteristics.

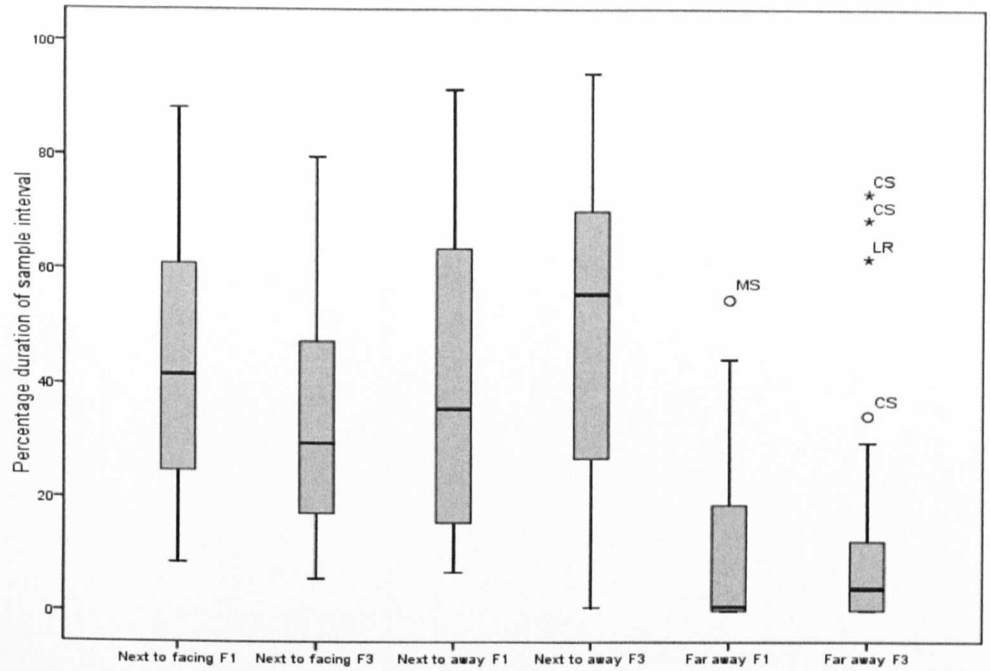


Figure 4.3a. 0-3min

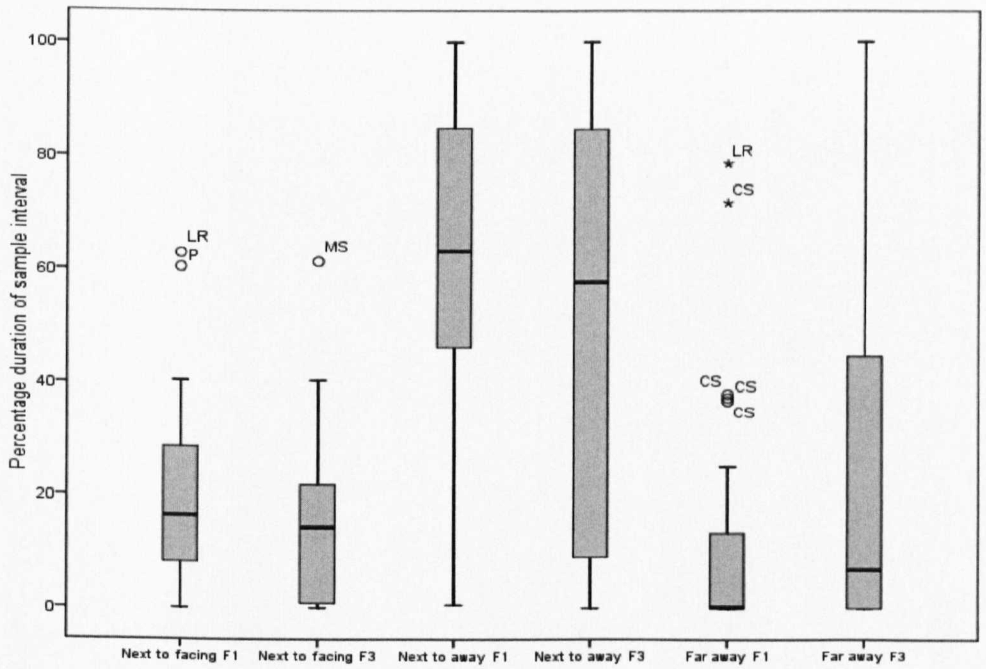


Figure 4.3b. 9-12min

Figure 4.3. Boxplots of duration (%) in each of the behavioural categories when the person was unfamiliar (F1) and familiar (F3) at 0-3 min (Figure 4.3a) and 9-12 min (figure 4.3b), by the 28 LSE dogs. Outliers are classified by breed group: LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel, P=Papillon. See Figure 4.1 for description of boxplot characteristics.

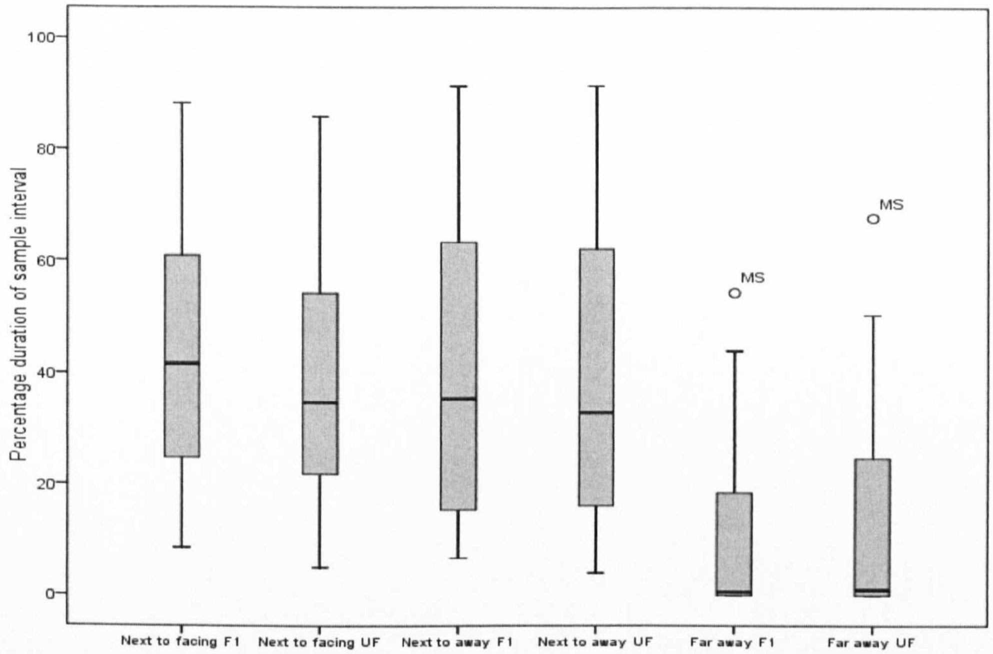


Figure 4.4a. 0-3 min

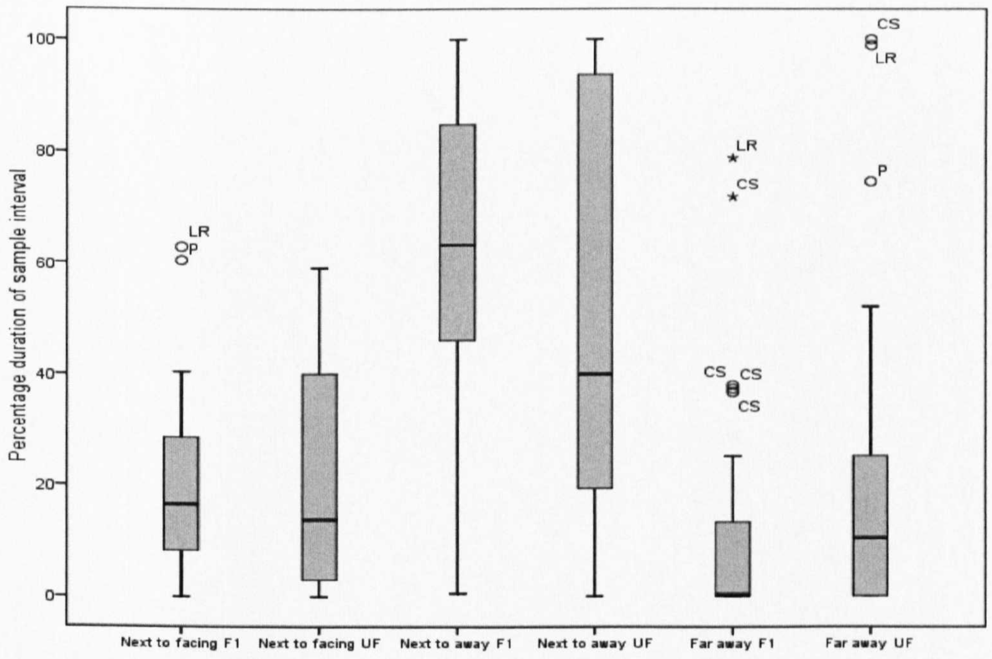


Figure 4.4b. 9-12min

Figure 4.4. Boxplots of duration (%) in each of the behavioural categories when the person was unfamiliar (F1) and unfamiliar (UF) at 0-3 min (Figure 4.4a) and 9-12 min (Figure 4.4b), by the 28 LSE dogs. Outliers are classified by breed group: LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel, P=Papillon. See Figure 4.1 for description of boxplot characteristics.

4.3.4. Order effect

The order in which the trials were presented (whether the dog received the 3 days of familiar contact (F1, F2, F3) or the day of unfamiliar contact (UF) first) had no effect on the duration of interaction in each of the behavioural categories at 0-3 min or 9-12 min (Table 4.8).

Table 4.8. The Z statistic and P value from multiple Mann-Whitney tests for order effects during interactions with familiar and unfamiliar humans at 9-12 min, by the 28 LSE dogs. P values followed by * were significantly different at P<0.05.

Behavioural category	Time period	
	0-3min	9-12min
Next to facing	0.511, 0.63	1.21, 0.24
Next to away	0.000, 1.00	1.21, 0.24
Far away	1.13, 0.30	0.391, 0.73

4.3.5. Breed differences

When comparing the 3 breed/size groups of the RH dogs, no differences were observed between the time spent in each of the behavioural categories by the medium, large or extra large size dogs during either the familiar or unfamiliar interactions, apart from the 'far away' category at 0-2min. (Table 4.9). However, this apparently significant result could be due to multiple testing (1/12 tests performed) and is therefore unlikely to be a reliable result to interpret further.

Table 4.9. The K statistic and P value from multiple Kruskal-Wallis tests for comparisons between breed size groups at 0-2 min and 8-10 min during interactions with humans, by the 25 RH dogs. P values followed by * were significantly different at P<0.05.

Behavioural category	Time period	Familiarity	
		Familiar (F)	Unfamiliar (UF)
Next to facing	0-2min	0.752, 0.69	0.065, 0.97
	8-10min	1.80, 0.41	1.06, 0.59
Next to away	0-2min	3.39, 0.18	0.112, 0.95
	8-10min	2.93, 0.23	0.375, 0.83
Far away	0-2min	7.03, 0.03*	1.87, 0.39
	8-10min	0.701, 0.70	3.34, 0.19

For the LSE dogs, breed differences were only observed for the familiar interactions (F3). Labrador Retrievers (LR) and Miniature Schnauzers (MS) spent more time 'next to away' the familiar person at 9-12 min (Mann Whitney Z=1.97, P=0.05; Z=3.05, P=0.001 respectively) than the Cocker Spaniels (CS), whilst the CS spent more time 'far away' than the MS (Z=3.09, P=0.002) during the same time period (Table 4.10, Figure 4.5). No breed differences were observed at 0-3min.

No adjustments were made for multiple testing in the case of the Mann Whitney tests. This is likely to increase the chance of a false positive result. However, of the three significant pairwise comparisons, two had a P value <0.01, reducing the likelihood of this effect. The significant difference between LR and CS at 9-12 min for 'next to away' behaviour may be due to chance as a result of multiple testing (P=0.05), although a larger sample size may have given a lower P value.

Table 4.10. The Z statistic and P value from multiple Mann-Whitney tests for breed differences during interactions with familiar humans at 9-12 min, by the 28 LSE dogs. P values followed by * were significantly different at P<0.05.

Behavioural category	Labrador Retriever (LR) vs. Cocker Spaniel (CS)	Cocker Spaniel (CS) vs. Miniature Schnauzer (MS)	Labrador Retriever (LR) vs. Miniature Schnauzer (MS)
Next to facing	0.232, 0.82	0.421, 0.72	1.16, 0.25
Next to away	1.97, 0.05*	3.05, 0.001*	1.74, 0.09
Far away	1.69, 0.94	3.09, 0.002*	1.72, 0.15

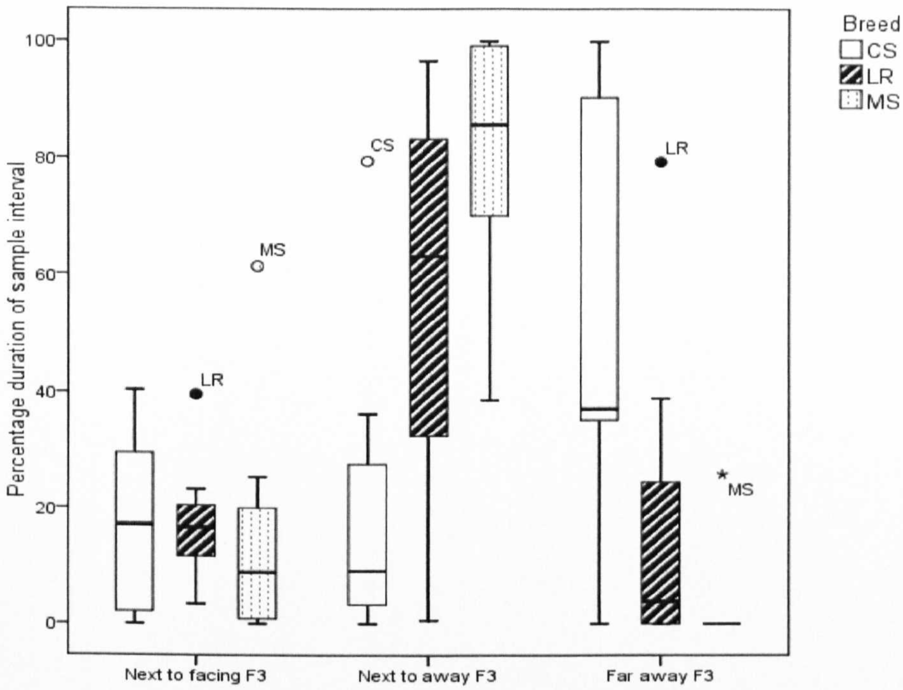


Figure 4.5. Boxplot of breed differences for duration (%) in each behavioural categories when the person was familiar (F3) at 9-12 min, by the 28 LSE dogs. Outliers are classified by breed group: LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel, P=Papillon. See Figure 4.1 for description of boxplot characteristics.

4.3.6. Gender differences

Insufficient numbers of male and female volunteers were available to observe the effect of gender of the familiar or unfamiliar person on the behaviour of the dog for the RH dogs. Gender of the volunteer did not affect the behavioural category of the LSE dogs during familiar (F3) or unfamiliar (F1 and UF) interactions at both 0-3 min and 9-12 min (Table 4.11).

Table 4.11. The Z statistic and P value from multiple Mann-Whitney tests for human gender differences during interactions at 0-3 min and 9-12 min, by the 28 LSE dogs.

Behavioural category	Time period	Familiarity		
		Unfamiliar (UF)	Unfamiliar (F1)	Familiar (F3)
Next to facing	0-3min	0.682, 0.52	0.964, 0.35	0.306, 0.78
	9-12min	1.30, 0.21	0.588, 0.58	0.190, 0.85
Next to away	0-3min	0.35, 0.75	0.823, 0.43	0.96, 0.35
	9-12min	0.165, 0.89	1.62, 0.11	1.48, 0.15
Far away	0-3min	0.471, 0.68	1.66, 0.12	1.76, 0.09
	9-12min	0.074, 0.96	2.14, 0.05	1.12, 0.31

4.4. Discussion

4.4.1. Effects of familiarity of human contact

Both the RH dogs and the LSE dogs remained keen to instigate human contact with both groups by remaining ‘next to’ the person (whether familiar or unfamiliar) throughout the whole interaction, reinforcing the idea that human contact in itself is highly valued for dogs used to human contact (Fox, 1986 cited in Hubrecht et al., 1992).

RH dogs

The large amount of time spent ‘next to’ both the familiar and unfamiliar person during the initial interaction (0-2min) supports the hypothesis that dogs require and instigate human contact (Head et al., 1997; Wells, 2004b). Despite suggestions that any human contact is desirable (Hubrecht et al., 1992; Wells, 2004b; Coppola et al., 2006), the difference found in the orientation of the dog indicates that familiarity can be important. Head et al. (1997) found that dogs remained in close proximity to a person when they entered the room during an open field test, whether familiar and unfamiliar; but when unfamiliar, more individual variation in behaviour was observed. The preference for 'next to facing' contact at 0-2 min when the person is familiar suggests a possible expectation of greater reward from familiar people, in the form of an anticipated walk or food, or simply a greater confidence in the familiar person to remain aware of the surroundings (Taylor and Mills, 2007). When the dog was with unfamiliar people, the greater 'next to away' behaviour suggests the dogs are more 'alert' to their surroundings with a reduced confidence in the unfamiliar person and therefore need to remain more vigilant to what is going on outside the kennel. Conversely, the lack of expectation of a reward from an unfamiliar person may fail to retain their attention whilst still meeting their need for contact.

The lack of any difference between the familiar and unfamiliar interactions at 8-10 min suggests that for both interactions, the dogs remain receptive to the human contact, choosing to spend a large amount of the interaction 'next to' the person, but the change in orientation of the RH dogs during the familiar interaction, to increased amounts of 'next to away' behaviour, may be a result of the anticipated reward not appearing and so reducing the value of the person somewhat.

The continued high levels of 'next to' behaviour at 8-10 min for both familiar and unfamiliar people show that, at least in the short term, human contact in any form is instigated and maintained by the dogs beyond an initial investigation of a novel person or expectation from a known person in the kennel. The presence of a person to interact with appears to be sufficient reward for them to approach and remain next to the person (Wells and Hepper, 2000), although the interest level in goings on outside the kennel increases over time.

LSE dogs

It could be concluded from the lack of difference in the amount of time spent at each distance/behaviour category between familiar (F3) and unfamiliar (UF) interactions that familiarity of the person is of no importance to the LSE dogs, supporting Tóth et al.'s (2008) idea that the familiarity of a person during play sessions did not affect play levels with well socialised dogs. As with the RH dogs, the high levels of 'next to facing' (29.7s and 34.9s F3 and UF respectively) and 'next to away' (55.6s and 48.6s F3 and UF respectively) behaviour maintained during the initial period (0-3min) suggest that the LSE dogs will instigate human contact so satisfying a need for social contact with people (Wells, 2004b). LSE dogs also appeared to remain satisfied with human contact as a sufficient reward by 9-12 min into the interaction, regardless of familiarity.

However, there were significant differences between familiar (F3) and unfamiliar (F1) distance/behaviour category, i.e. when the person remained the same. Removing variation due to the dogs' different reactions to different human volunteers may have made the test more sensitive and therefore able to extract significant differences due to familiarity. This could be examined in further trials where facilities are more able to accommodate these trials.

In contrast to the RH dogs, the LSE dogs were more interested in the unfamiliar (F1) than the familiar (F3) person, possibly because they are housed in a very stable and enriching environment with high levels of daily human contact. Therefore, the novelty of an unfamiliar person is likely to enrich their environment and warrant investigation, a difference that is sustained in the comparison between familiar and unfamiliar people since during the familiar interaction the dogs were more inclined to move 'far away', suggesting a waning interest in the familiar person at 9-12min. However, the LSE dogs would also not have anticipated a reward from the familiar person, unlike the RH dogs which would previously been rewarded by their familiar people.

4.4.2. Breed differences

The lack of any significant size class difference in the behaviour of the RH dogs towards the familiar or unfamiliar person indicates that preferences for human contact are consistent across breeds. Although this contrasts with a study by Head et al (1997), their breed differences during human interaction were based on breed groupings of 'beagles' and 'crossbreeds'. In addition to this, the significant result seen between the LSE dogs during the F3 interactions would suggest that breed may affect behaviour during interactions with humans, and the groupings of the RH dogs by size rather than actual breed may have obscured these differences.

The breed differences among the LSE dogs were only evident at 9-12 min during the familiar interactions, and suggest that the Cocker Spaniels are less interested than some other breeds in remaining near a person once they have become familiar. It is possible that as the novelty of the proximity of the person declines, they become more interested in returning to the familiarity of their home pen and lose interest in human contact or the trial situation.

4.4.3. Gender differences

Gender differences could only be analysed for the LSE dogs, but the lack of any effect of gender on the dogs' behaviour towards the person during familiar (F3) or unfamiliar (F1 and UF) interactions at both 0-3 min and 9-12 min would suggest that gender is not important during human interactions. This contrasts with Lore and Eisenberg's study (1986) suggesting that male dogs are less likely to approach unfamiliar men, and the observation by Hennessey et al. (1998) of more relaxed behaviours in dogs petted by female petters, although they suggest that this result may diminish when petters are familiar. As these studies were carried out at rescue centres, the difference in reaction to male petters could be due to past experiences (such as poor socialisation towards or bad experiences with men) and a female bias in the animal care staff. It was therefore unfortunate that no gender comparisons could be made on the RH dogs. Since the LSE dogs had an extensive socialisation programme with both men and women and should not have undergone any negative experiences with either gender, it may be that they have no reason to react differently to men and women.

4.5. Conclusion

Despite the behaviour of the dogs varying between the RH and LSE environments, the fact that differences do occur highlights the likelihood that the benefits of human contact vary according to familiarity to the dogs. It also confirms, as with the toy study in Chapter 3, that kennel environments should be assessed on an individual basis before assumptions are made about human contact enrichment provision (Hubrecht et al., 1992). However, the continued preference for human contact of any sort in both environments confirms the need for human contact that is widely suggested (for example, see HMSO, 1995; Serpell, 1995a; Wells, 2004b) and shows that 10 min (15 min for the LSE dogs) is not (except for the Cocker Spaniels) sufficient time for the dogs to exhaust their need for basic human contact even when it is unaccompanied by any other reward or play.

CHAPTER 5: THE EFFECT OF FAMILIARTY ON BEHAVIOUR OF KENNEL HOUSED DOGS DURING CONSPECIFIC INTERACTIONS

Abstract

Visual, auditory and olfactory contact between dogs is commonplace in kennelled environments, but if direct physical contact is prevented, stress and stereotypic behaviour can result, and so it has been recommended that such contact should be provided. This study has examined the previously uninvestigated effect of familiarity on the interactive behaviour of dogs during off-lead interaction.

Dogs from long stay enriched (LSE) kennels (N=22; 3 breeds) were taken individually to an enclosed field and allowed two 15 minute off-lead interactions with a non-focal dog, one familiar and the other unfamiliar. The behaviour of the focal dog and the distance between the dogs were recorded. The periods 0-3 min and 9-12 min were analysed as representative of different stages of the interactions.

Focal dogs spent more time 'in contact' and exhibiting 'interaction' behaviours with unfamiliar dogs than with familiar dogs, at 0-3min. At 9-12 min, familiar pairs spent more time at '<1 body length' and '1-5 body lengths' and more time being 'followed' than the unfamiliar, whilst unfamiliar pairs spent more time at '>5 body lengths' than familiar. This suggests that the initial interaction is more important when the dogs are unfamiliar. Once this 'greeting' has occurred, unfamiliar pairs are more likely to ignore each other than familiar pairs, investigating the field individually rather than together.

Breed differences were only observed at 0-3min. During familiar interactions the Miniature Schnauzers (MS) remained closer to the non-focal dog than did the Cocker Spaniels (CS) or Labrador Retrievers (LR). During unfamiliar interactions, MS and LR remained 'in contact' with the non-focal dog longer than CS. CS appeared less motivated towards conspecific interaction.

The study suggests that familiarity is an important factor when considering the effectiveness of conspecific contact as enrichment for kennel housed dogs.

5.1. Introduction

It is often recommended that dogs housed in kennel environments are, when possible, pair or group housed (Hetts et al., 1992; Hubrecht et al., 1992; Mertens and Umshelm, 1996). Visual, auditory and olfactory contact with other dogs is commonplace in kennelled environments, but the prevention of physical conspecific contact is likely to be frustrating and may increase stress and stereotypic behaviour, as the 'motivation to fulfil their inherent desire for social contact' is thwarted (Wells, 2004b). Conversely, visual contact alone increases the environmental complexity for the dogs (Poole, 1992 cited in Shepherdson et al., 1998) despite the potential to induce frustration. Housing laboratory dogs in isolation has been shown to lead to a stress response, both physiological, in terms of increased urinary and salivary cortisol (Beerda et al., 1999a) and behavioural, including increased vocalisation, autogrooming and coprophagy, and reduced resting behaviour (Hetts et al., 1992; Beerda et al., 1999b), whilst group housing increased activity levels, investigatory behaviour and reduced stereotypic behaviour (Hubrecht et al., 1992).

As with human contact, conspecific contact in rehoming and rescue centres is often dictated by the potential effect on rehoming success over and above welfare implications. It is considered important to provide visual conspecific contact for individually housed dogs (Wells, 2004b) and this has led to increased time spent at the front of the kennel, making the dogs appear more desirable to potential owners (Wells and Hepper, 1998). However, visual contact may also increase barking, a behaviour considered to have a negative impact on adoption success (Wells, 2004b) as well as having the potential to damage the hearing of the dogs (Sales et al., 1997).

Conspecific contact also carries the added risk of disease transmission, aggresion and injury (Hubrecht, 1995) and the high turnover and unknown history and compatibility of dogs in rescue centres makes pair housing particularly challenging (Dog's Trust, Salisbury Staff, pers. comm., Wells, 2004b).

During conspecific interactions, dogs readily engage in social interaction and play behaviour (Rooney et al., 2000; Hubrecht, 2002 cited in Overall and Dyer, 2005). Conspecific contact outside of the kennel may prove both positive for singly housed dogs in providing off-lead interaction, encouraging involuntary activity (Spangenberg et al., 2006) and social contact, whilst providing novelty and enrichment for group housed dogs and increasing investigatory behaviour of the environment (Hubrecht et al., 1992). Within this context, it is also important to consider the effect of familiarity of the conspecific on such interactions.

The study reported here compares the effect of familiar and unfamiliar conspecific contact on the level and quality of interaction exhibited by kennelled dogs from a LSE population. It also investigated the effect of breed of dog on the behaviour of the focal dog.

5.2. Methodology

5.2.1. Study site

This trial was carried out solely at the residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE). Since the life history and therefore conspecific sociability of the majority of the RH dogs was unknown, the trial was not considered appropriate to be carried out with the RH dogs. During this trial, the physical environment and husbandry routines were the same as described in Chapter 3. More general background information on the study sites, husbandry routines and study subjects is given in Chapter 2. The trial was carried out in an enclosed field normally used for off-lead exercise (0.97ha, Plate 5.1). Since the field was routinely used for daily exercise, it was not necessary to habituate the dogs to this field prior to the trial.

Plate 5.1. Enclosed field used to carry out the trial.

5.2.2. Study subjects

Twenty two adult neutered (1-8 years) LSE dogs (12 male, 10 female) were randomly chosen from the three breeds available; Labrador Retriever (LR) (N=8), Miniature Schnauzer (MS) (N=7) and Cocker Spaniel (CS) (N=7) at the time of the trial. Dogs considered by the staff as unsuitable for off-lead interaction with unfamiliar dogs were excluded from the trial.

All dogs had been born on site or brought in at approximately 9 weeks of age. The dogs had all received the same regime of socialisation and enrichment. Eighteen dogs had been used on the 'toys trial' (Chapter 3) and all 22 dogs were on the 'familiarity of human contact trial' (Chapter 4).

5.2.3. Procedure

The focal dog and a second, non-focal dog were simultaneously let off the lead in the enclosed field and their interactions recorded for a 15 minute period using a handheld video camera (Plate 5.2). Each focal dog was tested once with a familiar and once with an unfamiliar dog. The familiar dog was the focal dog's pen mate, and the unfamiliar dog was a dog of the same breed, sex and, where possible, colour as the familiar dog, and housed on another dog care unit on site, and was therefore likely to have had little or no prior interaction with the focal dog. One pet carer remained outside the field in visual contact of the dogs, approximately 15m away from the edge of the field; in case rapid intervention was needed.

Plate 5.2. Interaction between a focal dog and a familiar dog in the enclosed field.

5.2.4. Behaviours recorded

The videotapes were transcribed using Observer 5.0 (Noldus Information Technology, Nijmegen). Interactions with the familiar and unfamiliar non-focal dog were recorded for each focal dog in order to examine time spent at each distance from the non-focal dog (Table 5.1) and behaviours exhibited by the focal dog during each trial period (Table 5.2).

Table 5.1. Ethogram of distance between the focal and non-focal dogs.

Distance category	Description
In contact	Any part of the focal and non-focal dogs' bodies are touching
0-1 body length	The focal dog less than 1 of its own body lengths from the non-focal dog without touching
1-5 body lengths	The focal dog is between 1 and 5 of its own body lengths from the non-focal dog
>5 body lengths	The focal dog is over 5 of its own body lengths from the non-focal dog

Table 5.2. Ethogram of behaviours during conspecific interactions.

Behaviour	Description
Follow	The focal dog travels behind the non-focal dog who is moving away maintaining a distance of <5 body lengths
Followed	The non-focal dog travels behind the focal dog who is moving away maintaining a distance of <5 body lengths
Escape attempt	The focal dog makes attempts to leave the field under or through the fence or gate. Includes pawing at the gate/fence.
None	No interactive behaviours were observed between the two dogs
Interactions	Any interactions occurring between the two dogs, including playing, mounting, sniffing, aggression.

Distances were measured as body lengths of the focal dog as this was considered more accurate than trying to estimate absolute distance from video playback. It also took into consideration the size of the dog when looking at distance between the two dogs. Individual behaviours occurring between the two dogs were combined as 'all interactions' since even after grouping their occurrence accounted for less than 10% of behaviours. In the time periods analysed, 100% of the 'all interaction' behaviour was 'playing' (Appendix 5). 'Escape attempt' was categorised separately from 'none' in terms of interaction behaviours since it was a commonly exhibited behaviour by the dogs and might reflect social incompatibility or a desire to gain access to people.

5.2.5. Statistical analysis

Statistics were calculated using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. Since none of the data were found to be normally distributed, hypotheses were examined using non-parametric tests.

Preliminary analysis

Each 15 minute trial was split into three minute time periods in order to observe the frequency of behaviours over time following the introduction of the two dogs to the test field. Spearman's rank correlations were used on the whole data set to determine whether analysis was necessary on the whole 15 minute time period for each interaction, or whether some of the 3 minutes time periods were more highly correlated than others. Following this preliminary analysis, time periods of 0-3 min and 9-12 min were analysed to obtain an overview of the interactions.

Further analysis

Statistical analyses were carried out using two independent variables, familiarity of the non-focal dog, and breed differences, for both the familiar and unfamiliar interactions. Familiarity was compared using Wilcoxon tests to look at duration at each distance category and duration of specific behaviours.

In order to reduce variation in the data, breed differences were only compared for dogs with sufficient numbers of breed pairings. Therefore, the analysis only considered Labrador Retriever-Labrador Retriever, Miniature Schnauzer-Miniature Schnauzer and Cocker Spaniel-Labrador Retriever pairings of focal dog-non-focal dog respectively. This reduced the number of dogs analysed to 17 for breed comparisons. The effect of breed of the focal dog in both the familiar and unfamiliar situations was compared using Kruskal-Wallis tests followed by Mann-Whitney U tests to compare two breeds in the case of a significant result from the Kruskal-Wallis test. In order to look at the change in behaviour of the focal dog over time regardless of familiarity, the 0-3 min time period was compared to the 9-12 min time period for all familiar and unfamiliar interactions combined using Wilcoxon tests.

In a number of cases, medians were identical or very close but the statistical test gave a significant result. On these occasions, means were displayed as well as medians even though the mean was not the appropriate summary statistic for the non-parametric statistics used.

5.3. Results

5.3.1. Preliminary analysis

Following the division of the observations into five three minute time periods, the distance of the focal dog from the non focal dog was found to be correlated for all time periods for a random sample of 15 of the LSE dogs. However, the lowest correlations occurred between 0-3 min and all other 3 minute time period groupings. This was the case when looking at familiar and unfamiliar interactions both separately and combined (Appendix 6). In order to look more closely at the behaviour of the dogs over the 15 minute trial period, and to observe behaviour as well as distance, further analysis was carried out on 0-3 min (to include the period when the dogs first had opportunity to interact), and 9-12 min to give an overview of the remaining interaction.

5.3.2. Familiarity

Unfamiliar dogs spent more time 'in contact' than familiar dogs at 0-3 min (Wilcoxon, $Z=4.11$, $P<0.001$). At 9-12 min, familiar pairs spent significantly more time at '<1 body length' and '1-5 body lengths' ($Z=2.32$, $P=0.02$ and $Z=2.26$, $P=0.02$ respectively), whilst unfamiliar pairs spent more time at '>5 body lengths' ($Z=2.61$, $P=0.01$) (Table 5.3).

Table 5.3. The median duration (s) spent at varying distances when interacting with familiar and unfamiliar conspecific by the 22 LSE focal dogs. Medians in the same row displayed in bold were significantly different at P<0.05 by Wilcoxon tests.

Distance	Time period	Familiar	Unfamiliar
In contact	0-3min	**1.01**	**12.2**
	9-12min	0	0
<1 body length	0-3min	**14.0**	**11.3**
	9-12min	20.2	5.67
>5 body lengths	0-3min	**69.0**	**62.2**
	9-12min	57.5	79.8

Focal dogs in unfamiliar pairs spent more time exhibiting 'interaction' behaviour than familiar dogs at 0-3 min (Wilcoxon Z=4.11, P<0.001). At 9-12 min, focal dogs in familiar pairs spent more time being 'followed' by the non-focal than unfamiliar dogs (Z=2.37, P=0.02). There was no difference in the occurrence of any of the other behaviours between familiar and unfamiliar pairs at 0-3 min or 9-12 min (Table 5.4).

Table 5.4. The median and mean duration (s) spent exhibiting behaviours when interacting with familiar and unfamiliar conspecific by the 22 LSE focal dogs. Medians in the same row displayed in bold were significantly different at P<0.05 by Wilcoxon tests.

Distance	Time period	Familiar		Unfamiliar	
		Median	Mean	Median	Mean
Interaction	0-3min	**1.20**	2.95	**14.6**	16.0
	9-12min	0	1.85	0	3.70
Follow	0-3min	0	1.09	0	1.31
	9-12min	0	0.62	0	1.47
Followed	0-3min	0	0.41	0	0.13
	9-12min	**0**	0.65	**0**	0.10
Escape attempt	0-3min	1.09	4.86	3.80	5.14
	9-12min	4.38	16.7	4.34	15.8
None	0-3min	91.5	89.7	75.9	76.1
	9-12min	88.7	80.2	94.1	79.0

5.3.3. Behavioural changes over time

The focal dog spent more time 'in contact' with the non-focal dog at 0-3 min than 9-12 min (Wilcoxon Z=4.11, P=<0.001) as well as spending more time showing 'interaction' (Z=4.11, P<0.001). 'Escape attempt' behaviour was more commonly seen at 9-12 min than 0-3 min (Z=2.65, P=0.008). Time spent at all other behaviour and distance categories at 0-3 min compared to 9-12 min was equal (Figure 5.1).

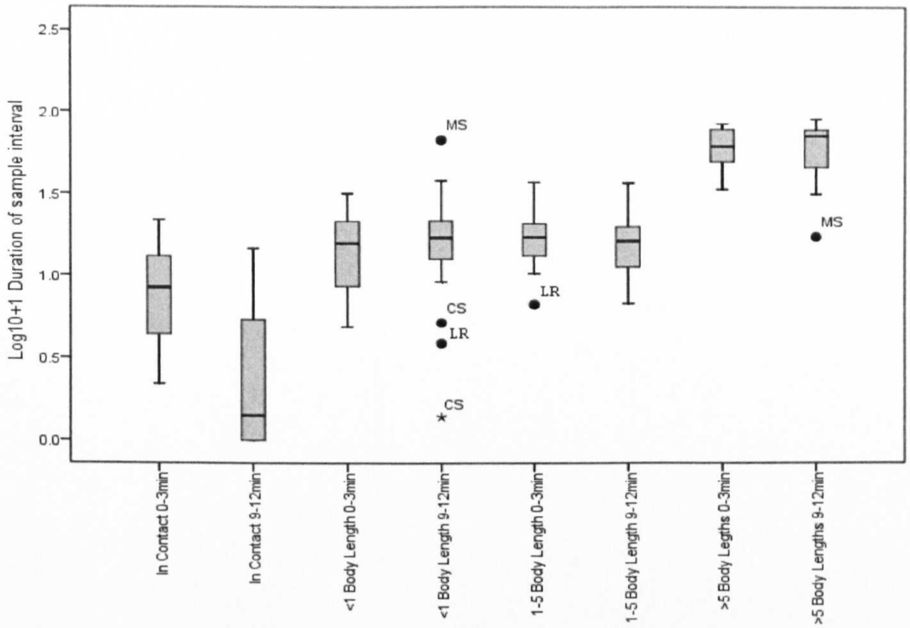


Figure 5.1a. Distance

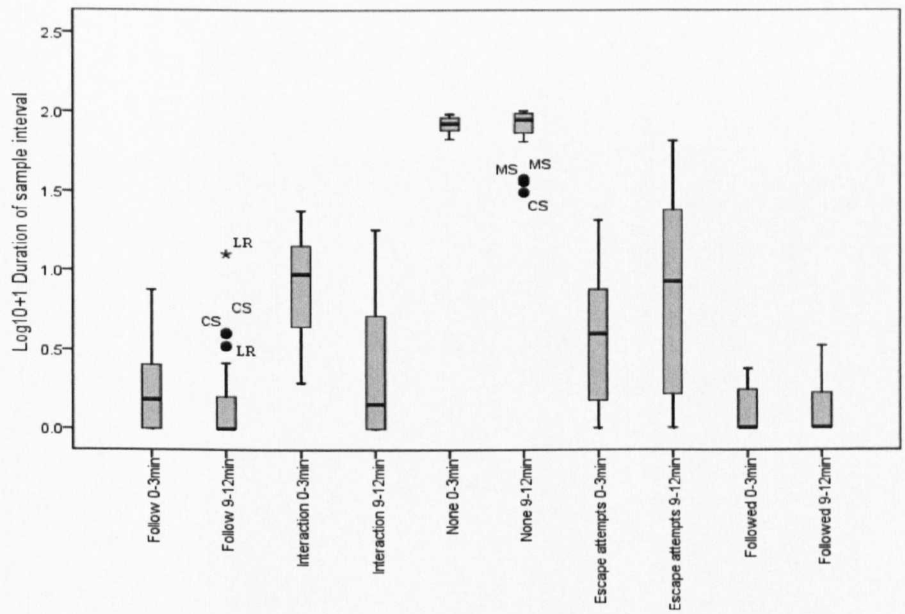


Figure 5.1b. Behavioural categories

Figure 5.1. Boxplots of $\log_{10+1}$ duration in each of the behavioural categories during 3 min intervals during off-lead conspecific interaction (familiar and unfamiliar combined) at 0-3 min and 9-12 min for distance (Figure 5.1a) and behavioural (Figure 5.1b) categories by the 22 LSE dogs. Outliers are grouped according to the breed of the focal dog: LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel. See Figure 4.1 for description of boxplot characteristics.

5.3.4. Breed differences

Breed differences in distance between dogs were only observed during the 0-3 min time period, during both familiar and unfamiliar interactions. Within this period, '1-5 body lengths' was the only behavioural category to show no breed differences during familiar or unfamiliar interactions (Table 5.5).

At 0-3 min, during familiar interactions the MS remained closer ('in contact' and '<1 body length' compared to '>5 body lengths') to the non-focal dog than did either the CS or the LR (Table 5.6a). During unfamiliar interactions, MS again remained closer to the non-focal dog than CS, but LR also remained closer ('in contact' and '<1 body length' compared to '>5 body lengths') than CS (Table 5.6b).

No adjustments were made for multiple testing in the case of the Mann Whitney tests. This is likely to increase the chance of a false positive result. However, the majority of pairwise comparisons had a P value <0.01, and all comparisons had a P value of <0.03, reducing the likelihood of this effect.

Table 5.5. The median duration (s) spent at varying distances at 0-3 min when interacting with familiar and unfamiliar conspecific by the 17 LSE focal dogs in 3 breed groups (MS=5, CS=5, LR=7). Medians for each distance, in the same column, followed by the same letter, were not significantly different at $P<0.05$ by pairwise Mann-Whitney tests between breeds: for details see Tables 5.6a and 5.6b.

Distance	Breed	Familiar	Unfamiliar
In contact	MS	4.80a	20.2a
	CS	2.27ab	5.24b
	LR	0.82b	14.5a
<1 body length	MS	27.9a	24.0a
	CS	11.8b	5.64b
	LR	12.7b	10.7ab
1-5 body lengths	MS	27.1a	19.7a
	CS	15.2a	15.6a
	LR	13.3a	11.9a
>5 body lengths	MS	44.1a	28.6a
	CS	72.1b	71.3b
	LR	69.4b	58.8ab

Tables 5.6a and 5.6b. The Z statistic and P value from multiple Mann-Whitney tests for breed comparisons at 0-3 min during interactions with familiar (Table 5.6a) and unfamiliar (Table 5.6b) conspecific by the 17 LSE focal dogs. P values followed by * were significantly different at P<0.05.

Table 5.6a. Familiar interactions

	MS vs. CS	LR vs. CS	LR vs. MS
In contact	1.36, 0.22	1.06, 0.34	2.84, <0.001*
<1 body length	2.19, 0.03*	0.90, 0.43	2.84, <0.001*
>5 body lengths	2.61, 0.01*	1.38, 0.20	2.84, <0.001*

Table 5.6b. Unfamiliar interactions

	MS vs. CS	LR vs. CS	LR vs. MS
In contact	2.19, 0.03*	2.84, <0.001*	0.08, 1.0
<1 body length	2.40, 0.02*	1.38, 0.20	1.87, 0.07
>5 body lengths	2.61, 0.01*	1.38, 0.20	1.38, 0.20

When observing individual behaviours during familiar interactions, breed differences were only observed at 9-12min. MS spent more time showing 'escape attempt' behaviour than CS or LR (Z=2.64, P=0.01; Z=2.20, P=0.03). The 'none' category was longer in duration in LR than CS and higher in CS than MS (Z=1.98, P=0.05; Z=2.43, P=0.02) (Figure 5.2a).

During unfamiliar interactions, breed differences were only observed at 0-3min. At this time period, CS showed lower levels of 'interaction' than LR and MS (Z=2.84, P=0.01; Z=2.20, P=0.03). Conversely, CS showed higher levels of 'none' behaviour than LR or MS (Z=2.84, P=0.01; Z=2.61, P=0.01) (Figure 5.2b).

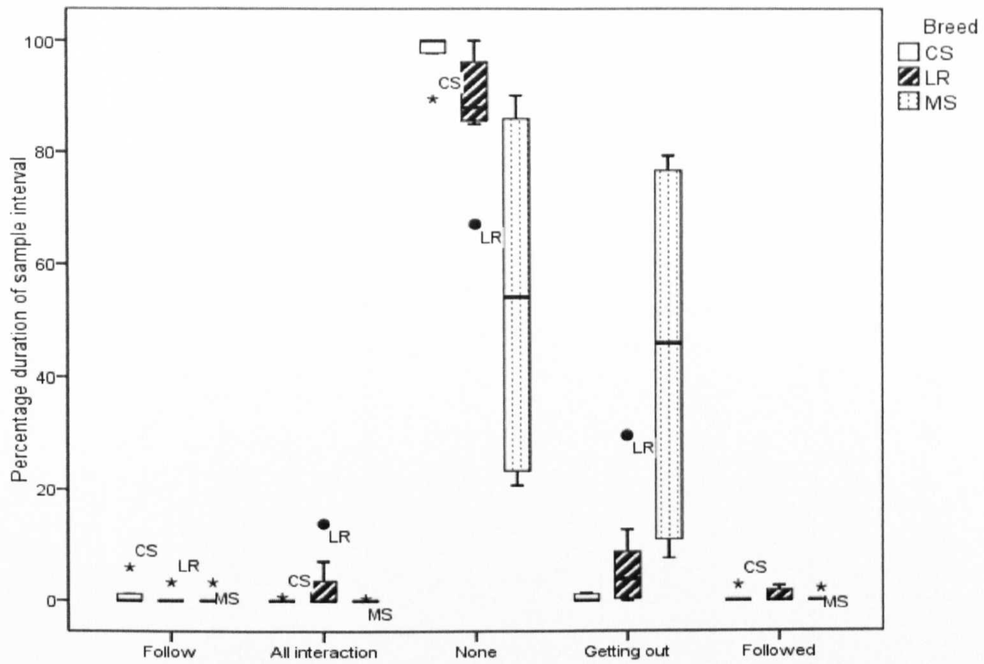


Figure 5.2a. Familiar individuals at 9-12 min

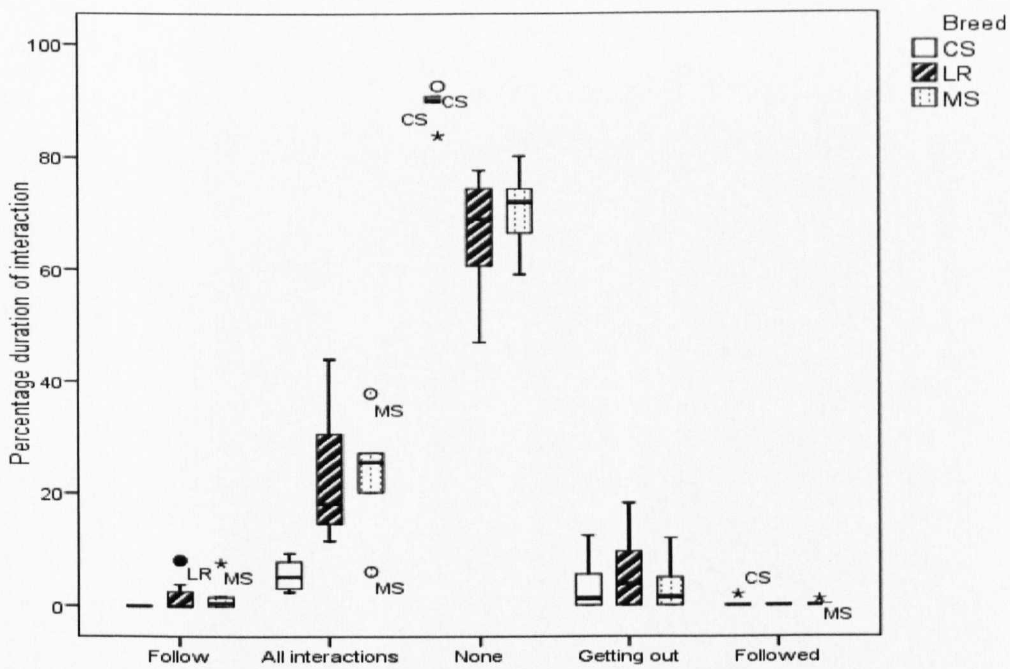


Figure 5.2b. Unfamiliar individuals at 0-3min

Figure 5.2. Boxplots of duration (%) in each of the behavioural categories during conspecific interaction with (Figure 5.2a) familiar individuals at 9-12 min and (Figure 5.2b) unfamiliar individuals at 0-3 min by the 22 LSE dogs. Outliers are grouped according to the breed of the focal dog; LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel. See Figure 4.1 for description of boxplot characteristics.

5.4. Discussion

5.4.1. Behavioural changes over time

By observing the overall behavioural changes between the two time periods studied, it is possible to gain an overview of the dogs' changing behaviour over the trial period regardless of familiarity. The significantly greater amount of time spent 'in contact' and showing 'interaction' behaviour at 0-3 min compared to 9-12 min confirms the familiarity data, that the main interaction occurs between the two dogs during the initial 'greeting' period. However, it does highlight the fact that this interaction is also present during both the familiar and unfamiliar initial interactions, but, as shown by the significant difference in 'in contact' and 'interaction' of the familiarity data, to a lesser degree when dogs are familiar.

Overall, the large percentage of the interaction spent at '>5 body lengths' and showing 'none' behaviour at both 0-3 min and 9-12 min suggest that although the interaction with the conspecific appears to be important, the majority of the potential interaction period is in fact devoted to investigating the environment separately rather than interacting with each other. By comparison, interactions observed between pet dogs during daily walks were limited to between three and 39 behavioural components, producing relatively short interactions comprising their initial meeting (Bradshaw and Lea, 1992).

It may be that, as with the familiarity of human contact in Chapter 4, the novelty of the conspecific declines following the initial interaction and they become more interested in investigating the environment, differing only in whether they do so together (when familiar) or apart (when unfamiliar).

5.4.2. Familiarity

The greater amount of time spent 'in contact' and showing 'interaction' behaviour by the unfamiliar compared to the familiar dogs at 0-3 min indicates a need for an initial 'greeting' period when dogs are unfamiliar. Following approach to a conspecific, interaction is mainly through olfactory inspection of the head and anogenital regions (Bradshaw and Lea, 1992), therefore requiring close contact (termed 'in contact' in this study). This initial interaction appears to be short lived, confirmed by the lack of correlation between 0-3 min and all the other 3 min time periods, and completed within the first three minutes of interaction. The same 'greeting' interaction occurs to some level in familiar dogs, although to a lesser degree, presumably since they are not only familiar but are housed together long-term, as opposed to simply having had previous encounters, reducing the amount of olfactory and visual information needing to be gained from the interaction.

At the 9-12 min time period, giving an overview of the remaining 12 minutes of the interaction, the larger amount of time spent '>5 body lengths' by the unfamiliar compared to the familiar pairs would imply that following the initial interaction, dogs that are unfamiliar are less inclined to stay in close contact and prefer to explore their environment separately. By comparison, the familiar pairs appeared to investigate more of the field together, spending more time at '<1 body length' and '1-5 body lengths' than the unfamiliar dogs without interacting, and more time being 'followed' by the non focal dog when familiar. This could be attributed to a degree of 'safety'. Once familiar, the dogs are better able to read each other's subtle cues and are therefore able to provide mutual support without the need to remain so cautious about each others' movements. This confirms Fox's (1975) study on a stable group of free ranging dogs where little social interaction or overt communication were observed, which he interpreted as the dogs being able to read more subtle cues due to their familiarity with each other.

When paired with an unfamiliar individual, both dogs may be more wary of the reaction of the conspecific and therefore feel safer away from the unknown dog whilst exploring, to avoid losing any resources they may find or risk confrontation and misinterpreted signals. A study of free ranging suburban dogs lacking strong group bonds have been reported to spend the majority of their time alone despite sufficient opportunity for conspecific interactions, possibly to avoid conflict in defending resources (Berman and Dunbar, 1983).

5.4.3. Breed differences

The MS appeared to be more motivated towards conspecific contact during the 'greeting' period of 0-3 min than the CS and to some degree the LR, spending more time at closer distances when both familiar and unfamiliar. Svartberg

(2006) attributes some of the behavioural differences between dogs to the show versus working strains, show dogs needing to have low levels of curiosity towards other dogs in order to ignore conspecifics when in the show ring (Svartberg, 2006). As the CS used for the trial were bred from show rather than working lines, this may explain their lack of inclination to engage in or instigate conspecific contact than MS or LR, spending less time at closer distances (<5 body lengths) and showing lower levels of 'interaction' behaviour than the other breeds during unfamiliar interactions.

It is also worth noting that the MS and LR focal dogs were paired with their own breed whilst CS were paired with LR (due to dog housing groups). Although the dogs were well socialised so should have no problem interpreting cues and interacting with other breeds, the interaction with a more or less paedomorphic breed may affect the behavioural response, both in terms of their own and that of the non focal dog (Goodwin et al., 1997; Leaver and Reimchen, 2008).

Comparisons between the MS and LR suggest a higher level of confidence and curiosity in the MS to instigate interactions. This trait, evident during the 9-12 min period, when with a familiar conspecific, suggests the MS are more motivated to escape from the field, possibly in order to investigate previously unexplored areas further away, and are therefore least likely to show any interaction with the conspecific. This complements Hart's (1985, cited in Hart, 1995a) study looking at American breed strains that MS are more excitable, active and territorial than L. However, a study of UK breeds suggested similar reactivity in both MS and L, whilst categorising MS with average aggressivity and immaturity compared to low aggressivity and high immaturity in LR (Bradshaw et al., 1996).

Despite the difference in 'getting out' behaviour mentioned above, the lack of any significant differences in the distance kept during familiar and unfamiliar interactions by the three breeds at 9-12 min suggests that breed has more of an effect on the way dogs greet and interact with each other during initial contact.

5.5. Conclusion

The difference in the behaviour of the dogs when paired with a familiar compared to an unfamiliar dog confirms that dogs react differently to their conspecifics according to their level of familiarity and breed. This would suggest that familiar and unfamiliar conspecific contact are likely to provide differing types of enrichment for dogs.

It is also worth noting that the LSE dogs used for this study were well socialised and therefore their responses to, and the ultimate benefits of, interaction may be different when compared to that of dogs housed in other kennel environments (Hubrecht et al., 1992). Pet dogs in the home, for example, meet conspecifics at a much lower frequency to the LSE dogs (23% 'one a week or more' and 6% 'every day') (Westgarth et al., 2008) whilst for dogs in rescue centres, unless deliberately pair or group housed, physical conspecific contact is generally very limited, due to the risk of infection, injury through social incompatibility or poor early socialisation and time constraints placed upon staff (Hubrecht et al., 1992; Hubrecht, 1995). It may be possible to increase the level of contact by increased supervised interaction, for example during on lead exercise.

CHAPTER 6: CHOICE BETWEEN DIFFERENT SOCIAL AND PHYSICAL ENRICHMENTS FOR KENNEL HOUSED DOGS

Abstract

The preceding chapters (Chapters 3, 4 and 5) describe investigations into the behavioural preferences for different types of potential enrichments (both social and physical) for two populations of kennel housed dogs.

Having determined preferences within enrichment categories (human, dog and toy), the trial described here gives some indication of the motivation of the dogs from one of the populations when choosing between these different categories.

A sample of LSE dogs (N=22) of three breeds were each trialled for 10 minutes on three consecutive days; once each with human vs. dog, dog vs. toy and human vs. toy choices. The potential enrichments (unfamiliar human contact, familiar conspecific contact and a squeaky bone toy) were offered in spatially distinct locations so that the subject dog had to move between them to indicate choice. To prevent the dogs from altering any of the enrichments, access to the all three was restricted; the toy was tethered, and physical contact with the dog and human enrichments was blocked. Duration spent near each enrichment and the gate leading out of the pen were recorded remotely, along with enrichment-directed and non-directed frustration behaviour.

The dogs spent more time near the gate than any of the enrichments. Comparing between enrichments, the dogs spent significantly more time near the human than the toy and more time near the dog than the toy. Similar amounts of time were spent near the human and dog enrichment. Within each choice, all 3 breeds spent similar amounts of time near the gate. However, breed differences were evident when comparing enrichments, with the MS spending longer near the dog than the toy compared to the other two breeds. Comparing the choices, MS and LR spent more time near the dog enrichment than the CS whilst only LR spent any time near the toy.

The differences in reaction to the different enrichments further confirms the idea that social contact is preferred as a potential enrichment by the dogs to physical enrichment. The large amount of time spent near the gate suggests a greater interest in activity outside the pen, and the possibility of being retrieved from an unfamiliar situation, than in any of the enrichments offered. The study also highlights that breeds respond differently to enrichments, as observed in

previous chapters in response to potential enrichment. However, it is worth noting that, (as has become evident in previous chapters) due to the high levels of socialisation and enrichment received by the LSE dogs on this study, their response is likely to be different to that of dogs housed in other kennel environments.

6.1. Introduction

The preceding chapters (Chapters 3, 4 and 5) describe investigations into the behavioural preferences for different types of potential enrichments (both social and physical) for two populations of kennel housed dogs. Having introduced in these chapters the well documented idea that environmental enrichment is important for kennel housed dogs (Hubrecht, 1993b; Wells, 2004b; Overall and Dyer, 2005), and considered the initial preference within enrichment categories, it has emerged that studies between enrichment categories are relatively limited. These often only go as far as to compare feeding enrichment with toy enrichment or to compare the long-term effects of different types of physical and social enrichment on behaviour, rather than the dogs' choice for them (Hubrecht, 1993b; Schipper et al., 2008).

Choice testing is a commonly used method of studying the initial selection of an animal for different types of enrichment, providing a discrete measure of behaviour. They have been an effective means of establishing initial choice in species ranging from dairy cows (Rioja-Lang et al., 2009) through to chickens (Jones et al., 2000) or rodents (Williams et al., 2008). Conversely, preference testing allows the evaluation of the internal state of the animal by observing motivation for resources satisfying the same motivational state (Kirkden and Pajor, 2006). Y-maze choice tests allow the animal a discrete choice between two possible enrichments, but are context specific since the preferred option is likely to be largely influenced by the alternative option (Kirkden and Pajor, 2006). Adaptation of the Y maze test allows the assessment of multiple resources and the motivational strength of the animal to avoid or obtain the resources, in terms of time spent near each one offered (Kirkden and Pajor, 2006). Although this gives an indication of choice between the enrichments offered, it does not show overall choice for each enrichment, if, for example, the alternative resources were altered.

The use of choice tests to study dogs is uncommon in the literature and has tended to focus on behavioural choices during longer term interactions, such as partner preference during social interactions (Ward et al., 2008) or food preference (such as Lupfer-Johnson and Ross, 2007) rather than short term responses to enrichment or resources.

In order to avoid providing unnecessary or ineffective enrichment programs in kennel environments, particularly where time and resources are limited, an overall initial ranking by the dogs of social and physical enrichment combined would be useful. Potentially, the optimum type of enrichment can be determined and it may ultimately be possible to provide kennel housed dogs with the enrichment most effective in improving their welfare.

Having determined preferences within enrichment categories (human, dog and toy), it is also useful to compare between enrichment types and ascertain whether dogs tend to prefer a certain type of potential enrichment when comparisons are made between categories, i.e. comparing human contact with dog contact and with toy enrichment.

This study examined the short term choice of dogs for the three categories of potential enrichment tested in earlier chapters (Chapters 3, 4 and 5) for kennel housed dogs. The rehoming centre could not provide a sufficient trial area to carry out the trial on RH dogs.

6.2. Methodology

6.2.1. Study site

The trial was carried out solely at the residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE). During this trial, the set up and husbandry routines were the same as during the 'preferences for different toy types and presentations in kennel housed dogs' study (Chapter 3). More general background information on the study site, husbandry routines and study subjects are given in Chapter 2. The trial was undertaken in the indoor area of a double pen joined by a door allowing the dog free access between the two sides ($6.10m^2$, Plate 6.1) in an area dedicated to the trial, away from the main dog housing. The dogs were habituated to this pen prior to the trial and the pen was cleaned between each trial.

Plate 6.1. Double pen used for the trial.

6.2.2. Study subjects

Twenty two adult (1-8 years, 20 neutered) LSE dogs (10 male, 12 female) were randomly chosen from the 3 breeds available; Labrador Retriever (LR) (N=8), Miniature Schnauzer (MS) (N=7) and Cocker Spaniel (CS) (N=7). All dogs had been born on site or brought in at approximately 9 weeks of age. The dogs had all received the same regime of socialisation and enrichment, detailed in Chapter 2. Five dogs had been used on the 'toys trial' (Chapter 3), five dogs were on the 'familiarity of human contact trial' (Chapter 4) and five on 'familiarity of dog contact trial' (Chapter 5). Sixteen dogs had not previously been used for any studies reported here.

6.2.3. Acclimatisation

Incorporated into their daily walks for the week preceding the trial, the dogs were taken to the empty trial pen and allowed to get used to being in the pen off-lead. This was continued until the pet carers were satisfied that the dogs were comfortable with the unfamiliar pen. At this point the dogs were not exhibiting signs of distress or nervous behaviours (such as low body posture) and were showing exploratory behaviour and positive interaction with the carer (e.g. play soliciting behaviour).

6.2.4. Enrichments

Three potential enrichments were used for this trial, an unfamiliar human (H), a familiar dog (D) (the trial dog's pen mate) and a toy (T). The type of each enrichment given was based on the results of previous trials looking at the initial preference within enrichment types (Chapter 3, 4 and 5). However, due to constraints of the study site, it was not possible to use the preferred enrichment type in each case. The familiar dog (pen mate) was used as dog contact as it was not possible to locate an unfamiliar dog for each interaction. The squeaky bone was considered a preferred type of toy when looking at short term choice (soft toys such as teddies were not considered suitable for 10 minutes of unsupervised interaction due to the risk of destruction and subsequent ingestion). Due to time and availability constraints, familiar human contact (11 male, 9 female volunteers; aged 25-45) could not be provided despite being considered optimum (Chapter 4), so human enrichment was limited to unfamiliar humans.

6.2.5. Procedure

Each dog was trialled on three consecutive days; once each with human vs. dog, dog vs. toy and human vs. toy choices. The order in which each choice was presented was randomised between each dog.

One enrichment was placed in each of the two outdoor pens (this was balanced for each choice trial to avoid any side bias). The trial dog was allowed access to the indoor pens and visual access to the outdoor part of the two pens (through locked dog flaps). In the case of the toy enrichment, the dog was allowed full indoor and outdoor access to the pen but the toy was tethered. Visual access was blocked between the two pens using hardboard screens so that the dog had to swap sides in order to have visual contact with the enrichment.

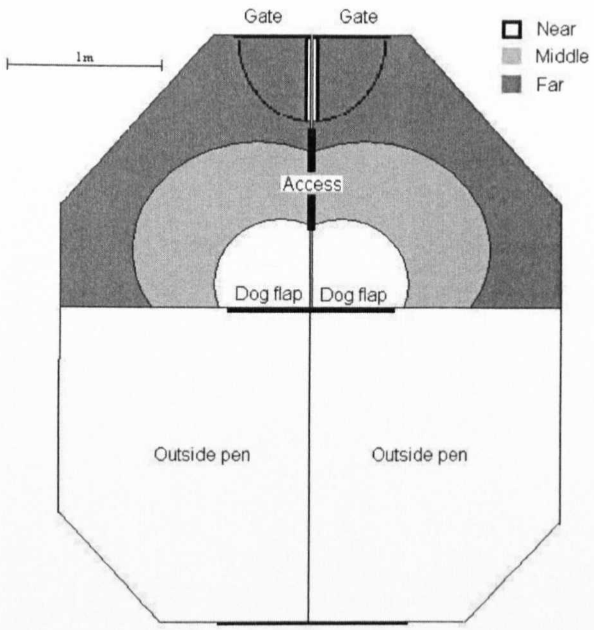
Once the enrichments were in place, the test dog was given access to the test area for a 10 minute period of observation.

The test area was cleaned between each choice with disinfectant/cleaners normally used to clean the pens to minimise the influence of other odours on the decisions of the dog in the trial.

6.2.6. Data recording

Interactions were recorded remotely using cameras mounted on the ceiling above the test pen, and therefore the dogs were not able to maintain visual contact with the experimenter. The tapes were subsequently analysed using the Observer 5.0 (Noldus Information Technology, Nijmegen) to quantify the amount of time spent in front of each of the areas containing the different enrichment, the amount of time spent near the gate (used to enter and leave the pen) and the amount of time in the central region (transitory region, occupied only briefly, and so not analysed) of the pen during each of the three choices for each dog (Plate 6.2). Since the area where the toy was tethered could be entered, time near the toy was only recorded for bouts greater than 5 seconds, to eliminate exploration of the trial pen rather than the toy itself. Frustration behaviours (jumping up at or pawing the door or gate), directed towards each of the three enrichments and the gate, as well as non-directed frustration behaviour, were recorded.

Plate 6.2. A typical kennel used for the trial at the LSE. Shading defines the approximate areas used for 'near', 'middle' and 'far' positions in the kennel.



6.2.7. Statistical analysis

Statistics were calculated using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. The 'time near gate' data were normally distributed and were therefore analysed using parametric statistics, and parametric analysis could also be carried out on the 'time near human' and 'time near dog' data following log10 transformations. All other hypotheses were tested using non-parametric statistics.

Wilcoxon tests on each of the three choice combinations were used to compare the 'total time near enrichment' and 'time near gate'. A repeated measures ANOVA was used to look at the 'total time near gate' across all three combinations of enrichments.

Time near each enrichment within the choices and subsequent breed differences were compared using multiple Wilcoxon tests, whilst overall times near each enrichment across the three choices were analysed using repeated measures ANOVA for the 'human' and 'dog' enrichments, and Chi squared for the 'toy' enrichment; since many dogs did not interact with the toy, this data was reduced to 0/1.

Directed and non-directed frustration behaviour across the three choices were compared using Friedman tests, followed by Wilcoxon tests on the directed frustration data, to look at breed differences.

6.3. Results

6.3.1. Total enrichment vs. gate

When presented with each of the three choices, the dogs spent more time near the gate than near any of the enrichments offered (Figure 6.1; Table 6.1).

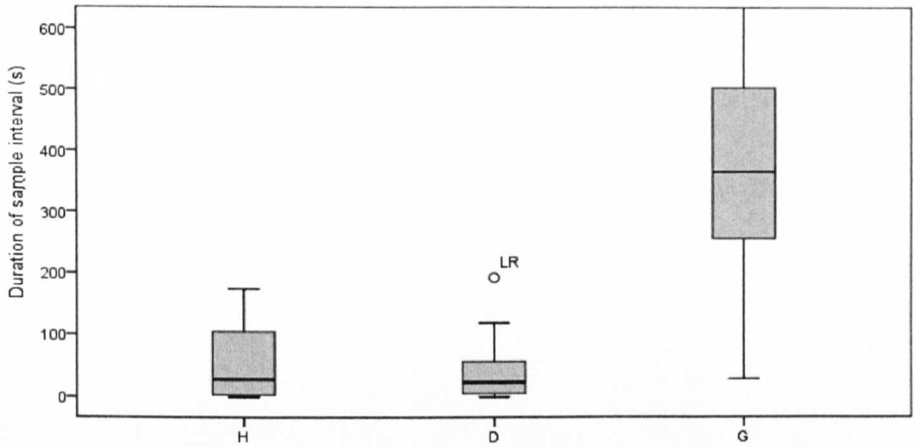


Figure 6.1a. H vs. D

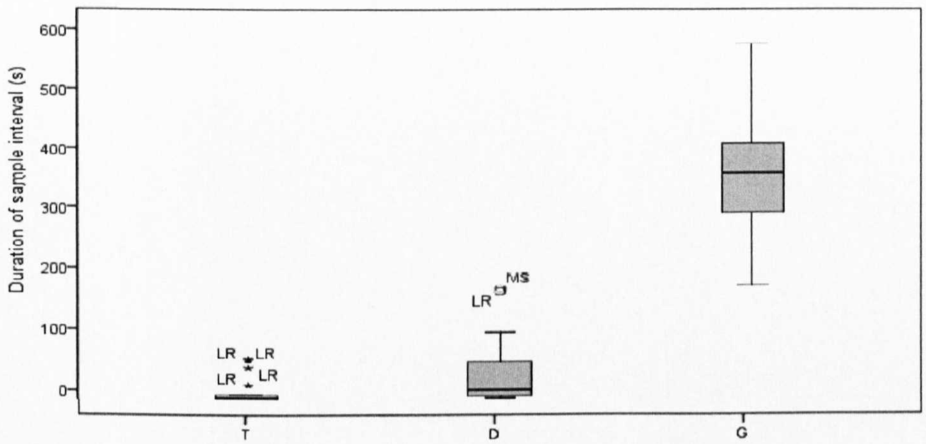


Figure 6.1b. D vs. T

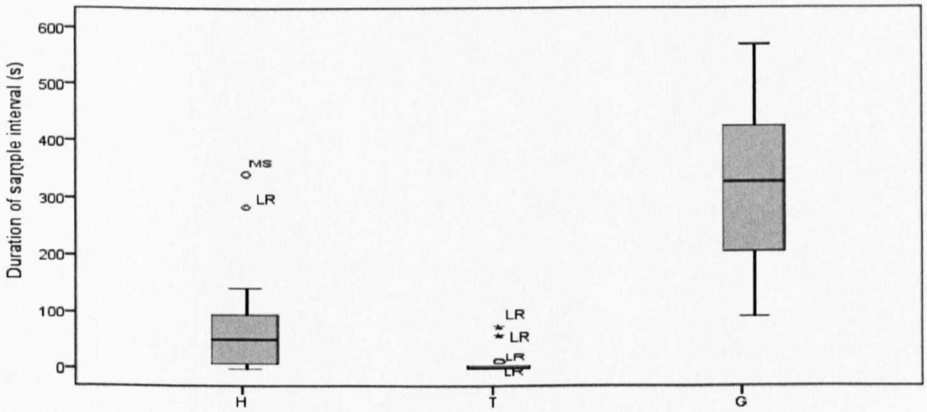


Figure 6.1c. H vs. T

Figure 6.1. Boxplots of total duration (seconds, out of a maximum of 600s) near each enrichment, and the gate leading out of the pen, for the Human vs. Dog (Figure 6.1a), Dog vs. Toy (Figure 6.1b) and Human vs. Toy (Figure 6.1c) choices, by the 22 LSE dogs. Outliers are labelled by breed. See Figure 4.1 for description of boxplot characteristics.

Table 6.1. The Z statistic and P value from multiple Wilcoxon tests for time spent near the gate (G) vs. the total enrichment (E) within each choice by the 22 LSE focal dogs. P values followed by * were significantly different at P<0.05.

Choice	Direction of effect	Z, P
H vs. T	G>E	3.65, <0.001*
H vs. D	G>E	3.78, <0.001*
D vs. T	G>E	4.11, <0.001*

6.3.2. Total time near gate

Combining the three tests, the total time spent near the gate was not affected by the combination of enrichments offered within the choice ($F_{(2,38)}$=0.891, P=0.42). Although not significant, there was a tendency towards a difference between breeds ($F_{(2,19)}$=2.59, P=0.10) with CS and MS showing slightly longer durations near the gate than the LR.

6.3.3. Time near enrichments (within each choice)

Dogs spent significantly longer near the human when offered the choice of human vs. toy (Wilcoxon Z=3.56, P<0.001) and more time near the dog when presented with the dog vs. toy combination (Z=2.61, 0.01). When offered the human vs. dog combination, the dogs did not spend a significantly greater amount of time near either of the two enrichments offered (Z=1.41, P=0.16) (Figure 6.1; Table 6.2).

Table 6.2. The Z statistic and P value from multiple Wilcoxon tests for time spent near the combination of two enrichments offered within each choice (human (H), dog (D) and toy (T)), by the 22 LSE focal dogs. P values followed by * were significantly different at P<0.05.

Choice	Direction of effect	Z, P
H v D	H = D	1.41, 0.16
D v T	D > T	2.61, 0.01*
H v T	H > T	3.56, <0.001*

During the human vs. dog choice, all three breeds spent more time near the gate than the dog or human and approximately equal amounts of time near the dog and human enrichments (Table 6.3; Table 6.4). All three breeds also spent more time near the gate during the dog vs. toy choice. However, the MS spent more time near the dog than the toy, whilst the CS and LR spent equal amounts of time near the dog and toy (Table 6.3; Table 6.4). When presented with the human and toy comparison, no breed differences occurred, with all three breeds spending more time near the gate than the human and more time near the human than the toy (Table 6.3; Table 6.4).

Table 6.3. The Z statistic and P value from multiple Wilcoxon tests for time (s) spent near the combination of two enrichments offered within each choice (human (H), dog (D) and toy (T)), by the 22 LSE focal dogs in three breed groups. P values followed by * were significantly different at $P<0.05$.

Choice	Breed		
	MS	L	CS
H vs. D	1.69, 0.091	0.14, 0.89	0.507, 0.61
D vs. T	2.37, 0.018*	0.70, 0.48	1.48, 0.19
H vs. T	2.20, 0.028*	1.82, 0.069	2.12, 0.028*

Table 6.4. The median duration near each enrichment (s) within each choice (human (H), dog (D) and toy (T)), by the 22 LSE focal dogs in three breed groups. Treatments in bold on the same row and choice category were significantly different at $P<0.05$ by multiple Wilcoxon tests.

Breed	H vs. D		D vs. T		H vs. T	
	Human	Dog	Dog	Toy	Human	Toy
MS	111	38.8	**51.3**	**0**	**10.6**	**0**
L	24.8	37.0	10.7	12.3	74.4	8.58
CS	40.2	26.4	3.12	0	**13.6**	**0**

6.3.4. Overall time near each enrichment

The large amount of time that the dogs spent near the gate (i.e. not expressing a choice between the enrichments) meant that the times spent near each of the enrichments could be regarded as quasi-independent from one another and could therefore be analysed separately. When comparing breed differences for the total amount of time spent near each enrichment across the whole trial (two out of the three choice trials in each analysis), no breed effect was seen for the human enrichment ($F_{(2,19)}$=1.86, P=0.18) (Figure 6.2a).

However, breed differences were observed when dogs were presented with the dog enrichment ($F_{(2,19)}$=5.76, P=0.011). MS and LR spent more time near the dog enrichment than the CS (at P<0.05) and there was a tendency towards the MS spending more time near the dog enrichment than the LR (P=0.059) (Figure 6.2b).

Overall time spent near the toy was low, with only five of the 22 dogs trialled remaining near the toy. All five of these dogs were LR, with none of the CS or MS near the toy. This breed difference in interaction with the toy enrichment was significant (Chi squared=11.3, df=2, P=0.03).

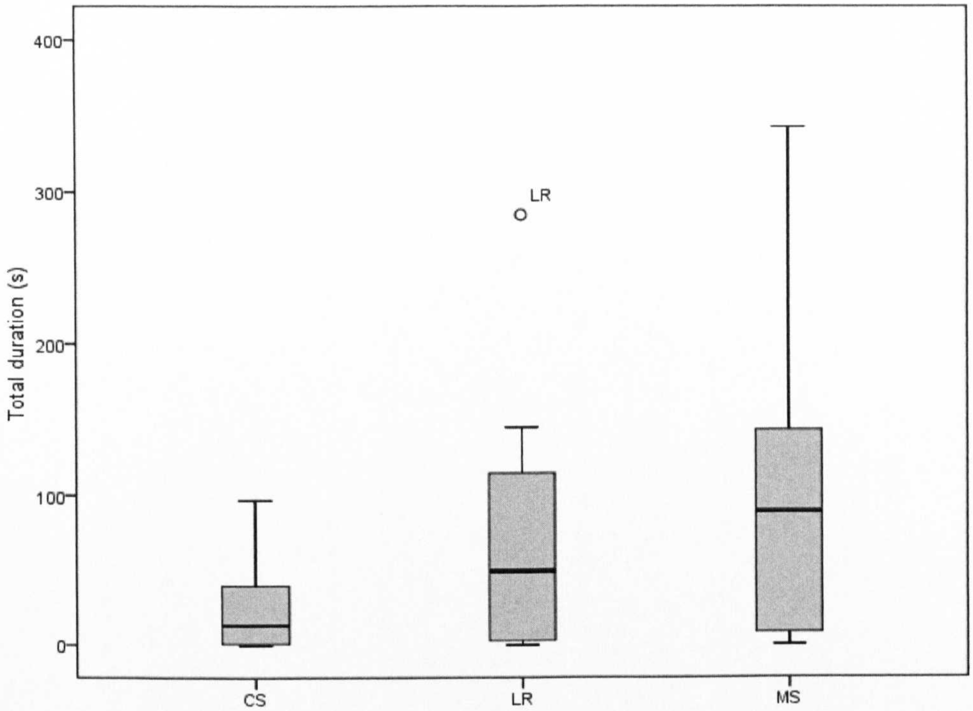


Figure 6.2a. Duration near Human enrichment

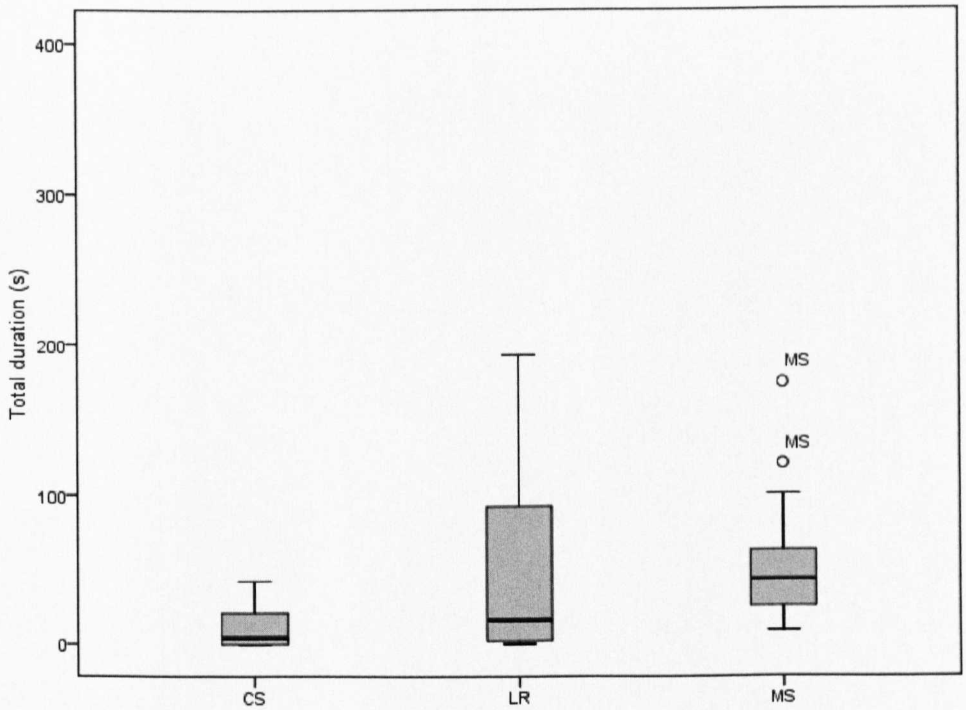


Figure 6.2b. Duration near Dog enrichment

Figure 6.2. Boxplots of total duration (seconds, out of a maximum of 600s) near each enrichment, by the three breeds for Human enrichment (Figure 6.2a) and Dog enrichment (Figure 6.2b), by the 22 LSE dogs. See Figure 4.1. for description of boxplot characteristics.

6.3.5. Non-directed frustration

When comparing the amount of non-directed frustration behaviour observed between the three choices of the trial, ten of the 22 dogs trialled did not show non-directed frustration behaviour in any of the three comparisons. Looking only at dogs that showed non-directed frustration behaviour in one or more of the three comparisons (N=12), there was no difference in the amount of non-directed frustration behaviour between the three choices (Friedman Chi squared=1.20, df=2, P=0.38).

6.3.6. Frustration towards each enrichment and gate

Overall, there was no difference in the amount of time spent showing frustration behaviour towards each enrichment during the human vs. dog choice (Friedman Chi squared=2.51, df=2, P=0.29), the dog vs. toy choice (Z=4.33, df=2, P=0.12) or the human vs. toy choice (Z=2.44, df=2, P=0.30).

There were not sufficient numbers of dogs showing directed frustration behaviour in each behavioural category to allow breed comparisons to be carried out for the human vs. dog choice. However, for the dog vs. toy choice, sufficient numbers of dogs showed directed frustration behaviour to allow comparisons between dog and gate for LR and MS. In this instance, MS showed a tendency towards more directed frustration to the gate than towards the dog (Wilcoxon, Z=1.60, P=0.11), whilst the LR showed a tendency towards higher levels of directed frustration towards the dog than the gate (Z=1.83, P=0.07).

For the human vs. toy choice, sufficient numbers of dogs showed directed frustration behaviour to allow comparisons between human and gate for all three breeds. CS showed more gate than human directed frustration behaviour (Z=2.00, P=0.046). MS and LR showed higher levels of human directed than gate directed frustration behaviour (Z=2.02, P=0.043 and Z=1.60, P=0.11 respectively).

6.4. Discussion

6.4.1. Gate effect

Despite the availability of two candidate enrichments throughout all three trials, the dogs actually spent most of their time in the intended "neutral" area nearest the gate out of the pen.

It could be concluded that from the choice of the gate over the provided enrichments, that interest in activity outside the pen, and the possibility of being retrieved from an unfamiliar situation, as was observed in the human contact trial (Chapter 4), makes the gate area more appealing than any of the enrichment provided. The occurrence of a significant difference for all three choices, between enrichment and the gate, suggests that regardless of the type of enrichment offered, the gate area remained more appealing than both enrichments combined. LR appear to be more interested in the enrichment than the MS or CS. Also, since the dogs were unable to interact physically with the enrichments (or in the case of the toy, remove it), their appeal may be limited to purely visual or olfactory attributes. Although Graham et al. (2005b) and Wells and Hepper (1998) highlight the importance of visual enrichment to kennel housed dogs, it is seen as a less appealing option to be used only when physical contact is not possible, and is therefore less likely to retain their attention since the behaviour triggered by the appearance of the enrichment cannot be followed through. However, dogs appear motivated to observe one another when physical contact is unavailable, suggesting visual contact may have greater value that is generally perceived (Wells and Hepper, 1998).

6.4.2. Time near enrichment (within choice)

Even though the dogs were able to manipulate (although not remove) the toy, the low level of interest in the toy (both overall and when compared to social contact) suggesting a lack of interest in the toy. Despite the human being unfamiliar and the dog familiar, dogs appeared to have equal preference for human and dog enrichment, presenting a clear distinction between social and physical enrichment, although not within social enrichment. Despite the limitations of the experimental design which will be reviewed in the general discussion (Chapter 9), these findings suggest a choice for social contact above physical enrichment. This complements the findings in earlier studies of the large amount of time spent near the human and familiar dog during the familiarity trials (Chapters 4 and 5) compared to the shorter time spent interacting with the toy (Chapter 3).

It had been expected that the dog enrichment might be preferred over the human enrichment, since they could provide visual, olfactory and auditory cues to the focal dog because the separation was via a Perspex dog flap. In contrast, the human volunteer, having been instructed to ignore the focal dog, provided visual cues that suggested unwillingness to interact. This further confirms the idea that dogs both require and instigate human contact (as seen in Chapters 3 and 4), an idea also proposed by Wells and Hepper (1998) that social contact itself is important to the dogs and they will actively seek it out. However, the trial does highlight that they appear not to differentiate one as more valued than the other. Added to this, visual (as mentioned earlier) and olfactory stimulation may have an important role as enrichment when physical contact with either humans (familiar or unfamiliar) or dogs is not possible (see Poole, 1998; Wells and Hepper, 1998; 2000). Since these dogs are normally group housed and receive high levels of human contact, the lack of difference between human and dog enrichment is perhaps unsurprising, although this may not hold for dogs housed in other kennel environments such as the RH kennels (as is evident when comparing kennel environments in earlier chapters (Chapters 3 and 4). This does, however, contrast with Hubrecht's (1993b) study on laboratory housed juvenile beagles, which showed that dogs offered toys spent less time engaging in conspecific contact. However, Hubrecht (1993b) does suggest that this may be a result of competitive and guarding behaviour towards the toys in a group housing situation, although this may be breed specific behaviour.

As with previous studies, the breed differences suggest that breed is a factor that should be considered when looking at choice and enrichment provision. The equal choice for the dog and toy enrichment by the LR and CS appears to have different underlying motivations. The CS lacked interest in either enrichment, confirming the findings in earlier chapters when looking at individual enrichments.

6.4.3. Overall time near enrichment

The varying overall time spent near each enrichment across the three breeds further confirms the breed differences evident in earlier chapters (Chapters 3, 4 and 5). The continuity between breeds for human contact supports the overall findings for the LSE dogs when offered only human contact (Chapter 4), suggesting an equal (although in this trial low level) interest in the human contact provided. The lack of time spent near the dog by the CS compared to the MS and LR supports the findings of Chapter 5, observing the effect of familiarity of conspecific on interaction. As has been suggested in Chapter 5, this difference may be explained by the low levels of curiosity towards other dogs bred into some show lines in order to ignore conspecifics when in the show ring (Svartberg, 2006). As with the toy preference trial (Chapter 3), the low number of dogs showing any interest in the toys restricted breed comparisons. However, in line with the previous trial in Chapter 3, this trial suggests that motivation for toys is breed specific. The reduction in interest in the toy when compared to Chapter 3 may be explained either by the provision of a different toy (although the squeaky bone was chosen as it was thought more likely to induce interest), or perhaps more likely, that the provision of social contact was of more interest to the dog than toy. These differences highlight the value of observing breed specific traits prior to providing potential enrichments.

6.4.4. Frustration behaviour

The low number of dogs exhibiting non-directed frustration behaviour would suggest that the restricted way in which the enrichments were presented did not lead to a frustration response in the dogs. Since the dogs trialled were well socialised and used to novel situations, they may not have found the situation stressful, and may therefore have been less likely to express frustration. Links have been suggested between frustration and stress in other species. Vestergaard et al., (1997) proposed a link in chickens between behaviours indicative of frustration and subsequently stress, and Dantzer et al. (1987) investigated the link between blood cortisol and frustration behaviour in terms of chain chewing in pigs during altered feeding conditions. It is likely, therefore, that if the dogs had found the test situation to be stressful, they are likely to have exhibited frustration behaviours as a result. Of those dogs that did show non-directed frustration, the lack of any difference between the choices suggests that no combination was more frustrating than any other.

The differing breed responses in levels of frustration behaviour further confirms Hubrect's (1993a) and Overall's (2005) suggestion that enrichment requirements may need to be breed specific. As with the human contact trial (Chapter 4), the CS remained interested in directing their frustration towards the gate, appearing motivated to return to their home pen over and above interacting with any enrichment offered. In contrast, the LR frustration behaviour directed towards the dog contact enrichment shows their strong interest in conspecific contact, as was seen in the dog contact chapter (Chapter 5). Alongside this, the higher levels of frustration behaviour by the MS and LR towards the human enrichment further confirm the breed differences seen in Chapter 4. However, it should be highlighted that the directed frustration response of all three breeds remained relatively low when compared to the time exhibiting no frustration behaviour (more than 70% of the trial period).

6.5. Conclusion

The differences in response to the different enrichments further confirms the idea that these dogs prefer social contact over toys as potential enrichments, even when the dogs were not able to interact with the humans or familiar dogs. The study also confirms the differences in preference between breeds, as observed in previous chapters in response to enrichment. However, it is worth noting that, as has already become evident in previous chapters, due to the high levels of socialisation and enrichment received by the LSE dogs on this study, their responses are likely to be different to those of dogs housed in other kennel environments.

CHAPTER 7: THE HABITUATION RESPONSE AND REBOUND EFFECT DURING OBJECT PLAY IN KENNEL HOUSED DOGS: CONSEQUENCES FOR ENVIROMENETAL ENRICHMENT

Abstract

Object orientated play is commonly used as a means of interacting with dogs and enriching their environment. Understanding the factors modulating the play response to objects would assist in optimising enrichment strategies for kennel housed dogs. The study aimed to determine what it is about a manipulable, interactive, 'play' object that leads to habituation and so indicate what might be altered to reinstate play, as well as determining the speed of habituation, and its likely mechanism, and therefore whether this can be manipulated to alter the habituation and disinhibition responses.

A preliminary study was carried out on a population of long stay enriched dogs (LSE dogs, N=22) from two breeds (Labrador Retriever (LR) (N=13) and Miniature Schnauzer (MS) (N=9). They were presented with one toy for successive short time periods until interaction with the toy ceased; at this point (defined as habituation), the second toy (identical but of opposing colour) was presented.

The average duration of interaction with the first presentation of toy 1 and the presentation of toy 2 were equal. This response shows a clear dishabituation following habituation, but does not fully illuminate the cause of this effect. Therefore, an extended trial was undertaken with a larger population of LR (N=16, 15 and 7 for phase 1, 2 and 3 respectively) to establish which cues led to habituation, and whether the manipulation of the time interval between presentations, pre and post habituation, could alter the subsequent habituation and rebound response, prolonging the interest in the toy. Phase 1 of the trial repeated the preliminary study altering the stimulus properties of the toy for colour and odour cues separately and together. Phase 2 altered the time interval between the final presentation of toy 1 and the presentation of toy 2 (between 10s and 15min). Phase 3 altered the time interval between each presentation of toy 1 to habituation (between 10s and 10min).

The rebound effect occurring in the preliminary study was also evident in phase 1 regardless of the cue altered. Variation of the time interval between habituation and dishabituation (phase 2) and between successive presentations of toy 1 (phase 3) had no effect on the level of dishabituation or the habituation response respectively.

The study suggests that loss of interest in the object during object orientated play is due to habituation to the overall stimulus properties of the toy rather than those within any single sensory modality, at least in the short term. Therefore, any change in the toy is likely to be sufficient to lead to a dishabituation response so long as motivation to play is unchanged. The time intervals between presentations do not appear to be a critical factor in the habituation and dishabituation responses of kennel housed dogs.

7.1. Introduction

The domestic dog is renowned for engaging in high levels of play, even when adult, and object orientated play is commonly used as a means of interacting with dogs and enriching their environment (Rooney et al., 2000). In Chapter 3, it has already been shown that object orientated play holds the attention of individually housed dogs when preferred play objects ('toys') are offered. Although this suggests a preference for soft 'toys' that make a noise and can be manipulated, it does not shed light on the function of the play interaction and subsequent habituation to the object. Dogs display powerful neophilia towards novel toys (Kaulfuß and Mills, 2008) and, anecdotally, they can also rapidly become disinterested in particular toys. The behavioural mechanisms that may lead to the latter, which are likely to include habituation, do not appear to have been investigated systematically.

Habituation and dishabituation have commonly been used to study behavioural responses to a given stimulus in a wide range of species (Tarou and Bashaw, 2007). Habituation, the ''response decrement as a result of repeated stimulation'' (Harris, 1943), is likely to impact on the effectiveness of any inanimate enrichment (Tarou and Bashaw, 2007). For example, successive presentations of enrichment objects to chimpanzees rapidly led to habituation towards those objects (Celli et al., 2003). Habituation was even observed when manipulable and play-inducing objects were offered, affecting their usefulness as long-term enrichments (Line et al., 1991; Maki and Bloomsmith, 1989 cited in Tarou and Bashaw, 2007). The dishabituation response is defined as a returning of the behavioural response to a level equal to that seen prior to habituation (Holmes, 1912 cited in Thompson, 2009), when the sensory characteristics of an object presented to the animal contrast sufficiently with those of the object to which habituation has been built up. This dishabituation response could potentially be used to restore interest in object play, and is therefore one of the key factors that could determine the effectiveness of enrichment using objects.

Object orientated play in domestic cats is motivated, as predicted, for predatory behaviour (Hall and Bradshaw, 1998) with habituation rapidly inhibiting exploration of the object unless its sensory characteristics change, as would happen during successful predatory behaviour. In this species, the dishabituation response when the sensory characteristics are changed can exceed that seen with the first presentation of the first toy (Hall et al., 2002), termed post-inhibitory rebound (Roper, 1984; Kennedy, 1985). Since the domestic dog also evolved from a predatory species (Coppinger and Schneider, 1995), it is possible this has led to a similar underlying motivation to object orientated play to that has been observed in cats (Hall et al., 2002). Social play in dogs is considered to be a means of learning appropriate social interaction (Feddersen-Petersen, 2008). However, solitary play is less common and its construction and motivation are poorly documented (Horwitz et al., 2002; Feddersen-Petersen, 2008).

In the preceding chapters, the initial preference for different types of enrichment, both within enrichment types (Chapters 3, 4 and 5) and between enrichment types (Chapter 6) for kennel housed dogs in both LSE and RH environments have been established. Since the stimulus characteristics of human and conspecific enrichments inevitably change somewhat during the test period, and those of the toy change little if at all, it is worth considering the effect of habituation and dishabituation on the latter. Establishing the motivation behind habituation to objects, and the nature of any subsequent rebound in response that restored object orientated play should help to determine the effectiveness of inanimate enrichment, the time interval needed between successive presentations of enrichment for effective or prolonged enrichment, and which cues lead to habituation and disinhibition.

This study aimed to determine what it is about a manipulable, interactive, 'play' object that leads to habituation, and what can be altered to reinstate play through dishabituation, as well as determining the speed of habituation, its underlying mechanism and whether it can be manipulated to sustain object play.

Preliminary study

7.2. Methodology

7.2.1. Study site

The preliminary study was carried out solely at the residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE). Facilities were not available to carry out the trial on the RH dogs. During this trial, the set up and husbandry routines carried out at the site was the same as during the 'preferences for different toy types and presentations in kennel housed dogs' study (Chapter 3). More general background information on the study sites, husbandry routines and study subjects is given in Chapter 2. The trial was undertaken in the indoor area of a pen in an area dedicated to the trial, away from the main dog housing. The dogs were habituated to this pen prior to the trial and the pen was cleaned between each trial.

7.2.2. Study subjects

Twenty two adult (1-8 years, 18 neutered) LSE dogs (12 male, 10 female) were randomly chosen from the two breeds available and considered suitable for the trial; Labrador Retriever (LR) (N=13), Miniature Schnauzer (MS) (N=9). Cocker Spaniels (the other available breed) were not considered toy motivated enough to be an appropriate breed for use on the trial.

Due to the limited number of suitable trial dogs housed at the LSE kennels, five dogs had been used on the 'toys trial' (Chapter 3), four dogs were on the 'familiarity of human contact trial' (Chapter 4), four on 'familiarity of dog contact trial' (Chapter 5), eleven dogs had been used on the 'choice test' trial (Chapter 6). Eleven dogs had not previously been used for any studies reported here.

7.2.3. Acclimatisation

Incorporated into their daily walks for the week preceding the trial, the dogs were taken to the trial pen and allowed to get used to being in the pen off-lead. This was continued until the pet carers were satisfied that the dogs were comfortable with the unfamiliar pen. At this point the dogs were not exhibiting signs of distress or nervous behaviours (such as low body posture) and were showing exploratory behaviour and positive interaction with the carer (e.g. play soliciting behaviour).

7.2.4. Procedure

Two manipulable objects were used for the trial, identical soft toys (Chubleez, UK) with an internal squeaker, varying only in colour (one blue and one brown/yellow) (Plate 7.1). The dogs were individually taken to the test pen and given 2 minutes to settle. The experimenter then presented the first toy over the pen gate (toy 1.1). After 30 seconds, the toy was removed from the kennel. Ten seconds later the same toy was re-presented (toy 1.2). This was continued until the dog no longer interacted with the toy for more than the first 10 seconds of the presentation (toy 1F) (maximum of 10 presentations, in line with the pilot trial findings). At this point (habituation), the toy was removed and ten seconds later, the second toy (toy 2) was presented. After 30 seconds the toy was removed, signalling the end of the trial. If any dog showed no interest in toy 1 after the first three presentations, or the dog continued to interact with toy 1 after 10 presentations (failed to habituate), the trial was terminated at that point.

The trial was performed on all 22 dogs. Eleven of the dogs were given the blue toy first and eleven dogs the brown/yellow toy, to balance the effect of any preference for either toy colour. The toys were washed prior to the start of the trial and between trials using the washing powder used to wash the dogs' bedding. Any handling of the toys was carried out using rubber gloves to minimise any preference due to deposited human scent.

The toys and test pen were cleaned between every dog trialled to avoid any effects of scent of other dogs on each trial.

Plate 7.1. The two soft squeaky toys, of contrasting colour, presented to the dogs during the trial.

7.2.5. Data recording

Interactions were recorded using remote video cameras mounted above the trial pen. An interaction was defined as anything other than sniffing or accidental contact, so included contact with the mouth or paw, such as mouthing, chewing and pawing at the toy.

The video recordings were analysed using Observer 5.0 (Noldus Information Technology, Nijmegen) to determine total duration of interaction (seconds) with the toy during each presentation, number of presentations of toy 1 to habituation and number of bouts of interaction with the toy during each presentation.

7.2.6. Statistical analysis

Data were analysed using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. Since the duration of interaction data were found to be non-normally distributed, the data were square-root transformed in order to carry out parametric statistics. A Fisher's exact test was used to compare levels of habituation and interaction with the toy between the two breeds. Since habituation was low for the MS, further analysis was only carried out on the 10 LR that habituated to toy 1 within 10 presentations.

One way ANOVA tests were used to look at the effect of presentation number (toy 1.1 vs. toy 2) on the number of bouts of play and the effect of presentation number on the average bout length and average and total duration of interaction with the toy. A one way ANOVA was also used to observe the effect of toy colour on the duration of interaction with the toy (to determine any colour bias in the order of presentation). The effect of number of presentations of toy 1 to habituation on the rebound effect (difference in duration of interaction with toy 1.1 and toy 2) was observed using Spearman's rank correlation.

7.3. Results

7.3.1. Number of trials to habituation

Of the 13 dogs that habituated within ten presentations of toy 1, the number of trials to habituation varied between two and nine, with an average number of four trials to habituation for the LR and five for the MS.

7.3.2. Breed differences

The levels of 'no interest' in toy 1, 'habituation' within 10 presentations of toy 1, and 'no habituation' after 10 presentations of toy 1 varied significantly between the two breeds (LR and MS) that were trialled (Fisher's exact=0.048) (Table 7.1).

Table 7.1. Habituation by the 22 LSE dogs in the two breed groups. LR=Labrador Retriever and MS=Miniature Schnauzer. 'Habituated' dogs stopped interacting with the toy within the first 10s following between two and ten presentations of toy 1. 'No habituation' dogs did not stop interacting within the first 10s of any of the ten presentations. 'No interest' dogs did not interact with the toy for more than 10s during any of the three presentations of toy 1.

Breed	Level of Habituation			Dogs Trialled (N/22)
	No Interest	Habituated	No Habituation (after 10 pres. toy 1)	
LR	1	10	2	13
MS	5	3	1	9

7.3.3. Habituation and dishabituation

The average duration of interaction by the LR between the first and final presentation (when dog no longer interacted beyond 10 seconds) of toy 1 (toy 1.1 and toy 1F respectively) and the presentation of toy 2, were significantly different (one way ANOVA $F_{(2,18)}=17.6$, $P<0.001$). Interaction with toy 1.1 and toy 2 were for similar durations. The average duration of interaction for each 30s period was marginally higher for toy 1.1 (14.0s) than toy 2 (11.3s), although not to a significant degree ($F_{(1,9)}=0.82$, $P=0.39$), with a much lower value for toy 1F (1.47s) (Figure 7.1).

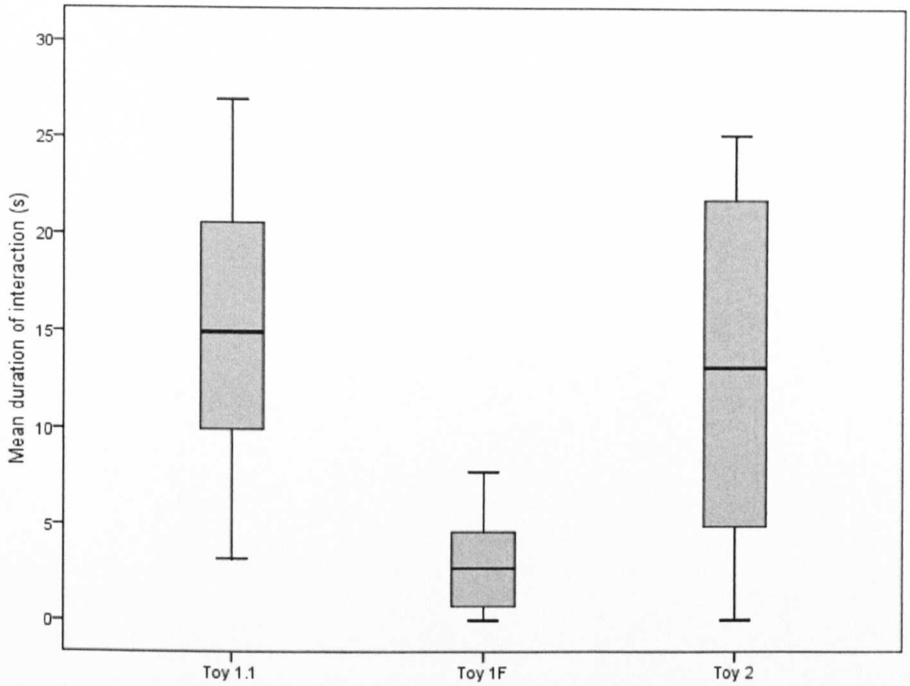


Figure 7.1. Boxplot of mean duration of interaction (s) with toy 1.1, toy 1F and toy 2 by the 10 Labrador Retrievers that habituated within 10 presentations. Means and standard errors were calculated from square-root transformed data and then back-transformed. Toy 1.1 = duration of interaction when first presented with toy 1; toy 1F = duration of interaction when dog habituated to toy 1 (defined as interacting in 1st 10 seconds of presentation only); toy 2 = duration of interaction with 2nd toy following habituation to toy 1.

Individual dogs also differed in their total duration of interaction with the three presentations (toy 1.1, toy 1F and toy 2) ($F_{(9,18)}$=3.45, P=0.01), indicating that play motivation was higher in some than others.

The average number of bouts of interaction with the toy during each 30s presentation was higher for toy 1.1 (2.3s) than toy 2 (1.5s) ($F_{(1,9)}$=10.3, P=0.011). Although the average duration of the bouts was not significantly different ($F_{(1,8)}$=0.221, P=0.65), it was slightly higher with toy 2 (6.1s) than toy 1.1 (4.8s).

7.3.4. Effect of trial number on rebound effect

The number of trials to habituation, as a measure of time to habituation, was not found to influence the magnitude of the dishabituation (difference in duration of interaction with toy 1.1 and toy 2) by the LR (Spearman's Rho=0.158, N=10, P=0.66).

7.3.5. Toy colour

When looking at the effect of toy colour on duration of interaction by the 10 LR, no difference was observed when the blue toy was used as toy 1 and the brown/yellow toy as toy 2, or vice versa (1 way ANOVA $F_{(1,8)}=0.340$, P=0.58).

7.4. Discussion: Preliminary study

7.4.1. Breed differences

As seen in preceding chapters, the difference in levels of interaction between the two breeds suggests that the MS have a differing pattern of response to the toys than the LR, supporting the findings of Bradshaw et al. (1996) that breed variation is evident in the play behaviour of dogs. The results suggest that the experimental setup used in this trial is not an appropriate means of measuring the habituation response of MS since the majority of them did not interact with the toy. It may simply be that the chosen toy was not favourable enough for solitary interaction by the MS; they had appeared to be less toy motivated than the LR in previous trials (Chapters 3 and 6), but a different toy might have induced play in a larger proportion of the sample.

The occurrence of a habituation and rebound response by the majority of LR suggests that a similar habituation response occurs with (some) dogs as has been shown in studies on cats (Hall et al., 2002). However, further comparisons suggest slight differences between the responses of the two species. In cats, the rebound effect following habituation can induce a greater level of interaction with toy 2 than with the first presentation of toy 1 (termed disinhibition) (Hall et al., 2002). Conversely, the LR rebounded to an almost equal level of interaction with toy 2 as was seen with toy 1.1 (dishabituation). This would imply a subtle difference in the mechanism of the habituation and rebound response. This could be attributed to the effects of domestication and subsequent motivation to interact with the toy. Feral dogs are known to survive by scavenging rather than hunting, suggesting a modification of hunting behaviour as a result of domestication. This could explain the differences observed in the habituation and dishabituation responses of cats and dogs despite both being domesticated carnivores (Macdonald and Carr, 1995; Bradshaw, 2006). Alternatively, since post-inhibitory rebound in cats varies according to the interval between the presentation of the toys (Hall et al., 2002), it is possible that rebound might be observed in dogs under different experimental protocols.

7.4.2. Number of trials to habituation

The time it takes for the dogs to reach habituation does not appear to be a contributing factor to the level of the rebound response observed, supported by the lack of correlation between the number of trials to habituation and the magnitude of the rebound.

7.4.3. Toy colour

Although toy colour effects on presentation order were balanced throughout the trial, the dogs appeared to show no colour preference for either the blue or brown/yellow toy. Although dogs are thought to be unable to distinguish blue and violet wavelengths or at the other end of the spectrum to distinguish green and yellow colours (Miller and Murphy, 1995; Miklósi, 2008), the trial toys, chosen to be at opposite ends of the dog's visual spectrum, should have been sufficiently visually distinct to the dogs, suggesting that a colour preference was not evident.

7.4.4. Conclusion

This preliminary study has established that a habituation and dishabituation response could be achieved in the dogs, but it is likely that the underlying motivations are marginally different to those seen in cats as the observed rebound response occurred to differing degrees (Hall et al., 2002). Further investigation is needed to determine what it is about the toy that leads to the habituation response by the dogs, therefore giving a clearer insight into the value of toys as enrichment.

The obvious differences between the two toys that may lead to dishabituation are colour, i.e. a visual difference, and a possible change in intensity of the odour cues, built up over repeat presentations of toy 1 (e.g. from deposited saliva). Alongside this, the time interval between presentations both pre and post habituation may be key in extending the time to habituation and the rebound effect produced.

Therefore, an extended trial was undertaken with a larger population of LR to establish which cues lead to habituation and whether the manipulation of the time interval between presentations, pre and post habituation can alter the habituation and subsequent rebound response, prolonging the interest in the toy.

Extended study

7.5. Methodology

7.5.1. Study sites

This study was again only carried out at the LSE kennels. Due to a lack of available free kennel space, the trial was undertaken in the meeting room in one of the dog housing areas (approximately 4.2x4.0m; Plate 7.2). The dogs were acclimatised to this room prior to the trial as part of their daily walks.

Plate 7.2. The meeting room used for both the extended habituation trials.

7.5.2. Study subjects

Sixteen adult (1-8 years, 13 neutered) LSE dogs (9 male, 7 female) were randomly chosen from the Labrador Retrievers (LR) available at the time of the trial. In the preliminary study, Miniature Schnauzers did not show sufficient interest in the toys used as enrichment and therefore this methodology was not considered a suitable means to measure their habituation and dishabituation. Cocker Spaniels (the other available breed) were not considered toy motivated enough to be an appropriate breed for use on the trial. All dogs were trialled for phase 1 (see section 7.5.4). In phase 2, one dog that had not shown any interest in the toys in phase 1 was not trialled. Seven dogs that had interacted with and subsequently habituated to the toy in phase 2 were trialled in phase 3.

Due to the limited number of suitable trial dogs housed at the LSE kennels, one dog had been used on the 'toys trial' (Chapter 3), one dog was on the 'familiarity of human contact trial' (Chapter 4) and one on 'familiarity of dog contact trial' (Chapter 5). Two dogs had been used on the 'choice test' trial (Chapter 6) and five on the preliminary habituation study detailed in this chapter. Seven dogs had not previously been used for any studies reported here.

7.5.3. Acclimatisation

Incorporated into their daily walks for the week preceding the trial, the dogs were taken to the trial room (Plate 7.2) and allowed to get used to being in the room off-lead. This was continued until the pet carers were satisfied that the dogs were comfortable with the unfamiliar room. At this point the dogs were not exhibiting signs of distress or nervous behaviours (such as low body posture) and were showing exploratory behaviour and positive interaction with the carer (e.g. play soliciting behaviour).

7.5.4. Procedure

Phase 1: The effect of visual and olfactory cues on habituation

Trials were carried out on days 1, 3 and 5 of each test week, with a distraction day on days 2 and 4 to reduce the expectation of subsequent trial days and to minimise any carry-over of habituation due to previous treatments.

Phase 1a (visual and olfactory cues)

Phase 1a was a repeat of the preliminary study using a larger number of dogs in order to establish a baseline level of interaction since the trial area had been altered and a new population of dogs were used for the study. This was carried out on day one of the trial.

As in the preliminary study, two manipulable objects were used for the trial, identical soft toys (Chubleez, UK) with an internal squeaker, varying only in colour (one blue and one brown/yellow). The dogs were individually taken to the test room and given two minutes to settle. The experimenter then presented the first toy (toy 1.1) and left the room. After 30 seconds, the toy was removed from the kennel. Ten seconds later the same toy was re-presented (toy 1.2). This was continued until the dog no longer interacted with the toy for more than the first 10 seconds of the presentation (toy 1F) (up to 10 presentations). At this point (habituation), the toy was removed and 10 seconds later, the second toy (toy 2) was presented. After 30 seconds the toy was removed, signalling the end of the trial. If any dog showed no interest in toy 1 after the first three presentations, or the dog continued to interact with toy 1 after 10 presentations (failed to habituate), the trial was terminated at that point.

The toys were washed prior to the start of the trial and between trials using the washing powder used to wash the dogs' bedding. Any handling of the toys was carried out using rubber gloves to minimise any preference due to human scent. Half the dogs were given the blue toy first and half the dogs the brown/yellow toy to avoid any bias towards either toy colour (although the preliminary study showed no colour bias).

Phase 1b (olfactory cues)

Phase 1a was repeated, except that both toy 1 and toy 2 were the same colour. This restricted the contrast, between the last presentation of toy 1 (1F) and the presentation of toy 2, to the absence of the dogs' own olfactory cues placed on the toy through saliva etc during the repeated presentation of toy 1.

Phase 1c (visual cues)

Phase 1a was repeated, but the dogs were presented with a different (clean), toy of one colour every time toy 1 was presented, followed by a clean toy of the opposite colour once habituation had been reached (toy 2).

The dogs were randomly allocated to one of two groups, so that half received phase 1b on day 3 and phase 1c on day 5 whilst the other dogs received phase 1c on day 3 and phase 1b on day 5.

The one dog that did not show an interest in the toys in one or more of the phase 1 treatments, was removed from the study prior to phase 2 and 3.

Distraction days (day 2 and 4)

The dog was taken to the test area and given 2 minutes to settle. The experimenter entered the test room but no toy was given. After 30 seconds the experimenter entered the room in the same way she had done when removing the toy, and then exited the room. This was repeated a further 10 times to reduce the anticipation of a toy being presented every time the experimenter entered the room.

Phase 2: The effect of delay on dishabituation

The method used for phase 2 was similar to that used in phase 1, but was modified to look at the effect of varying the delay in presenting toy 2 (after 1F) on the disinhibition response. The two types of toys from phase 1 were again used for phase 2, both identical soft toys with an internal squeaker. The colour and number of clean toys used was determined by which of the toy combinations had caused the greatest number of dogs to habituate in phase 1 (1c, visual cues only; 1b, olfactory cues only; or 1a, a combination of visual and olfactory cues). Therefore, the toy combination used in phase 1a (the same toy for toy 1 followed by the opposing colour toy for toy 2) was chosen (see Table 7.2).

Each dog was taken individually to the test room and given two minutes to settle. It was then presented with the first toy (toy 1.1). After 30 seconds, the toy was removed from the room. Ten seconds later the same toy was re-presented (toy 1.2). This continued until the dog no longer interacted with the toy for more than the first 10 seconds of the presentation (toy 1F) (up to 10 presentations). At this point, the toy was removed. Following a time interval of 10s, 30s, 1 min, 5 min, 10 min or 15 min, the second toy (toy 2) was presented. After 30 seconds the toy was removed, signalling the end of the trial.

Each dog was trialled over an 11 day period with the six delay intervals presented in a random order for each dog. Distraction, as for phase 1, was performed on the days between each trial day.

Phase 3: The effect of time interval between presentations on habituation

The procedure was identical to phase 2, except that the interval between the last presentation of toy 1 (1F) and the presentation of toy 2 was fixed at 10s, and the interval between all presentations of the first toy was varied with a different time interval on each trial day (10s, 30s, 1 min, 3 min, 10 min).

Each dog was trialled over 9 days with varying time intervals between toy 1 presentations. Each trial day was followed by a distraction day, as per phase 1.

7.5.5. Data recording

Interactions with the toys were recorded using remote video cameras mounted above the trial pen. As with the preliminary study, an interaction was defined as anything other than sniffing or accidental contact, so included contact with the mouth or paw, such as mouthing, chewing and pawing at the toy.

The video recordings were analysed using Observer 5.0 (Noldus Information Technology, Nijmegen) to determine total duration of interaction (seconds) with the toy during each presentation and the number of presentations to habituation.

7.5.6. Statistical analysis

Data were analysed using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. None of the data were normally distributed, so hypotheses were examined using non-parametric tests. Dogs that failed to habituate within 10 presentations of toy 1, or did not show any interest in the toy after three presentations were excluded from further analysis.

Proportions of dogs reaching criterion for habituation were compared by Chi-square tests. A Friedman test was applied to the phase 1 data to compare the effect of treatments 1a, 1b and 1c on the number of presentations of toy 1 to habituation. Wilcoxon tests were then used to look at pairwise comparisons between the three treatments. Rebound (difference in duration of interaction with toy 1.1 and toy 2) and dishabituation (difference in duration of interaction with toy 1F and toy 2) effects were compared between the three treatment groups (1a, 1b and 1c) using Kruskal-Wallis tests.

Rebound and dishabituation effects were also compared between the six time intervals of the phase 2 data using Kruskal-Wallis tests. For phase 3, comparisons between the number of trials to habituation were made between the five time intervals using a Friedman test.

7.6. Results

7.6.1. Phase 1: Visual and olfactory cues

The number of dogs habituating within 10 presentations was similar for all three treatments (Chi-squared=0.915, P=0.63) (Table 7.2).

Table 7.2. Habituation during the three trials in phase 1 for all 16 dogs. 'Habituated' dogs stopped interacting with the toy within the first 10s following between two and 10 presentations of toy 1. 'No habituation' dogs did not stop interacting within the first 10s of any of the 10 presentation. 'No interest' dogs did not interact with the toy for more than 10s during any of the first three presentations of toy 1.

	Phase		
	1a	1b	1c
Habituated	11	10	8
No habituation	4	5	7
No interest	1	1	1

Comparing the three treatments of varying colour and olfactory cues together (1a), and olfactory cues (1b) and colour cues (1c) independently, no effect was observed on the number of trials to habitation for the dogs that habituated in one or more treatments (N=11) (Friedman Chi Squared=2.31, P=0.32). All pairings between the treatments were compared to assess whether some were more similar than others (treatments 1a and 1b were identical up to the point of habituation), but their distribution of P values appeared to be random (Experiment 1a vs. 1b, Wilcoxon Z= 0.893, P=0.37; Experiment 1a vs. 1c, Z=0.281, P=0.78; Experiment 1b vs. 1c, Z=1.59, P=0.11).

The rebound effect (difference in duration of interaction between toy 1.1 and toy 2) across the three treatment groups remained consistent (Kruskal-Wallis=0.67, P=0.72). There was also no significant difference in the dishabituation response of the dogs (difference in duration of interaction with toy 1F and toy 2) across the three treatment groups (Kruskal-Wallis=0.81, P=0.67) (Figure 7.2). Treatments could therefore be combined by averaging. This combined dishabituation response was significant (Wilcoxon Z=2.85, P=0.004). The median of the average rebound for each dog was 4.0s, which was not significantly different from zero (Wilcoxon Z=0.62, P=0.53), indicating that play had returned to approximately its original intensity after the toy was changed.

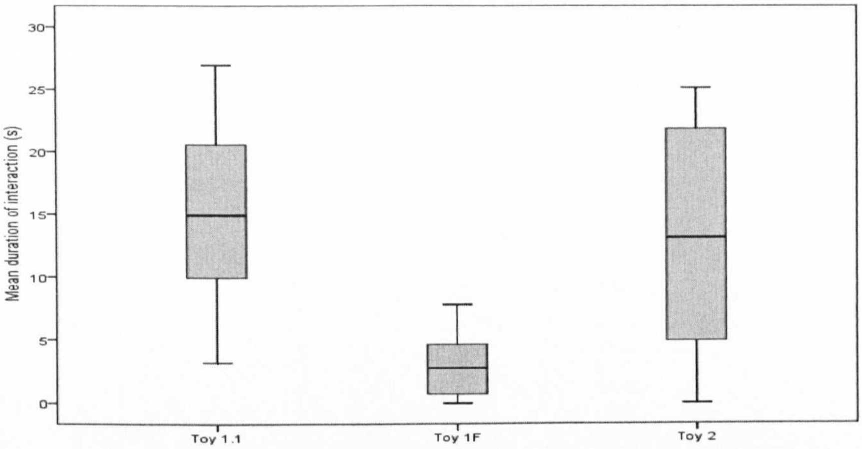


Figure 7.2a. Phase 1a. Visual and olfactory differences between toy 1 and 2.

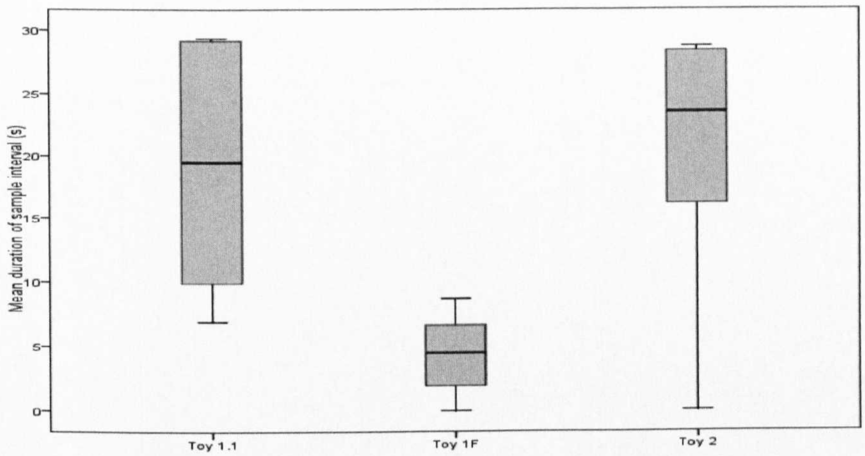


Figure 7.2b. Phase 1b. Visual differences only between toy 1 and 2.

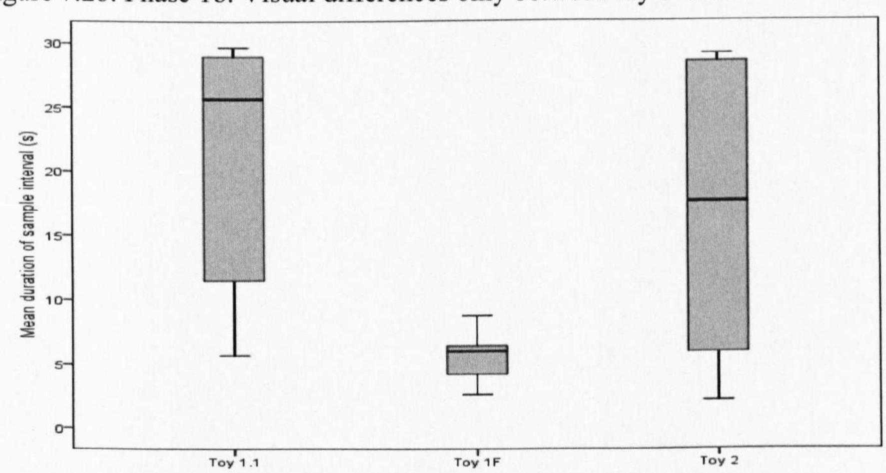


Figure 7.2c. Phase 1c. Olfactory differences only between toy 1 and 2.

Figure 7.2. Boxplots of mean duration of interaction (s) with toy 1.1, toy 1F and toy 2 by the dogs that habituated within 10 presentations (11, 10 and 8 for phase 1a, 1b and 1c respectively) for phase 1a (Figure 7.2a), 1b (Figure 7.2b) and 1c (Figure 7.2c). See Figure 4.1 for description of boxplot characteristics.

7.6.2. Phase 2: The effect of time delay on dishabituation

Varying the time interval (10s up to 15 min) between the final presentation of toy 1 (once habituation had been reached) and the presentation of toy 2, did not affect the rebound effect (Kruskal-Wallis=1.56, P=0.91) or the dishabituation response (Kruskal-Wallis=6.05, P=0.30). The durations of play for the first presentations of the two toys (1.1 and 2) were similar to those in phase 1 (Figure 7.3).

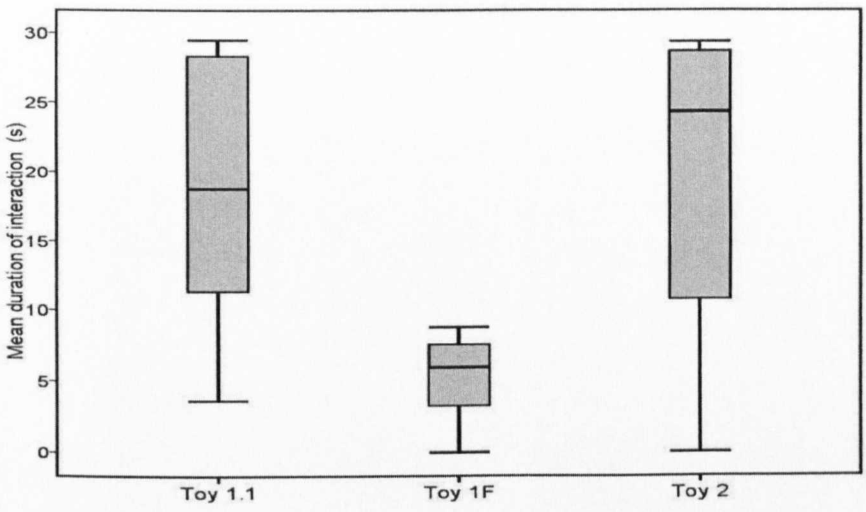


Figure 7.3. Boxplot of mean duration of interaction (s) with toy 1.1, toy 1F and toy 2 by the 12 dogs that habituated within 10 presentations in phase 2. See Figure 4.1 for description of boxplot characteristics.

7.6.3. Phase 3: The effect of time interval between presentations on habituation

Altering the time interval (from 10s up to 10min) between each presentation of toy 1 up to the point of habituation had no effect on the number of presentations to habituation (Friedman Chi Squared=2.48, P=0.65). The median number of presentations to habituation was 4 for the 10s, 30s, 3 min and 10 min time intervals and 3 for the 1 min time interval. The habituation and dishabituation response remained consistent when compared to phases 1 and 2 (Figure 7.4).

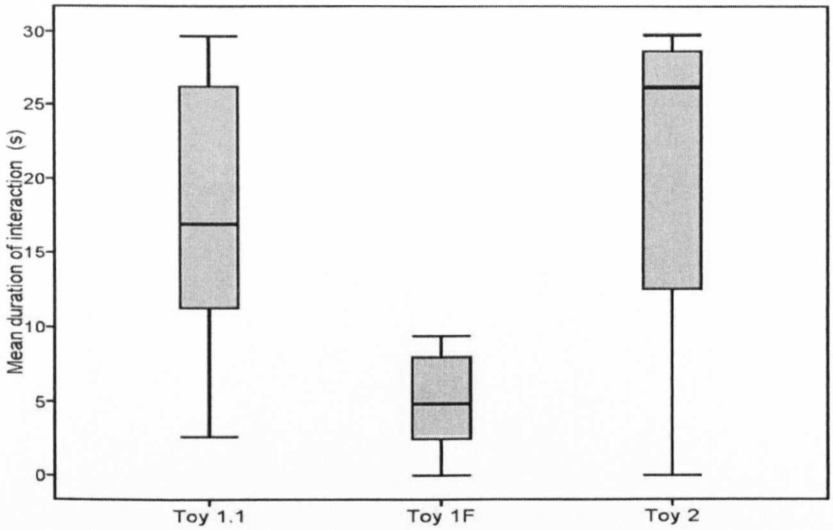


Figure 7.4. Boxplot of mean duration of interaction (s) with toy 1.1, toy 1F and toy 2 by the seven dogs that habituated within 10 presentations in phase 3. See Figure 4.1 for description of boxplot characteristics.

7.7. Discussion: Extended study

7.7.1. Phase 1: Visual and olfactory cues

All the trials confirmed that dogs habituate rapidly to manipulable objects, and that changes in the sensory characteristics of the objects lead to resumption of play, confirming the habituation and dishabituation responses seen in the preliminary study. The size of the rebound upon dishabituation shows that the dogs' motivation for object play had not diminished to any great extent over any of the combinations trialled. Changes in colour and (presumed) odour cues appear to be equally effective in causing dishabituation; this suggests that the alteration of any cue, whether visual or olfactory, may be sufficient to induce dishabituation. Habituation therefore appears to occur in parallel to each of the stimulus properties of the toy, rather than any individual cue taking precedence. A remote possibility that has to be considered is that the habituation response is primarily driven by cues besides colour or odour, although it is unclear what these could be, and this would not explain why dishabituation is almost complete when only colour and/or odour are changed.

Thompson (2009) suggests that whenever regular presentation of a stimulus occurs in a behavioural study, habituation will become evident. All mammals able to exhibit a habituation response to a stimulus appear capable of showing a dishabituation response to it (Harris, 1943 cited Thompson, 2009). By viewing dishabituation as the 'neutralisation' of the habituation, a distinction can then be made between that and 'fatigue' (Humphrey, 1933 cited in Thompson, 2009). In rats, the habituation response was found to occur when presented with either auditory or tactile cues. However, a generalised habituation response was also apparent but not clearly distinguishable between increased habituation or decreased sensitisation to the stimulus (Vogel and Wagner, 2005).

Over time, the habituation response can become more rapid through training and recovery (Thompson, 2009) or simply through repeated presentation of unchanging objects (Tarou and Bashaw, 2007). This was not evident in the trial reported here, possibly because each dog was only subjected to three trial periods in phase 1 and a combination of distraction days, delays between phases (of a number of weeks) and randomisation of trial orders within phases were all employed to negate these potential effects.

Therefore, when looking at maintaining interest in objects provided as enrichment, it would appear that for those aiming to induce play behaviour, it may be possible to rekindle interest by altering any cue from the toy that is perceptible by the dog, so long as the toy remains a desired play object and motivation to play has not diminished (Celli et al., 2003; Tarou and Bashaw, 2007). If the latter is the case, play is unlikely to restart, at least within 30 minutes or so, regardless of the changes made. In a range of species, Murphy et al. (2003) suggest that, when offered highly valued enrichments, such as those containing food, interaction with the enrichment to gain the food reduces over time as the effect of the reinforcer reduces (and therefore habituation increased), rather than a result of fatigue or satiation.

7.7.2. Phase 2: The effect of delay on dishabituation

The dishabituation response appears to be insensitive to the duration of the delay since habituation. However, the relatively short maximum time interval used (15 min) may not have been sufficient to induce an observable effect. The disinhibition response in cats did not diminish until the delay reached 25 min (Hall et al., 2002), so the same response may occur in dogs if the time interval was extended beyond 15 min. The post-inhibitory rebound occurring in cats when the time interval was reduced to 5 min was not observed in the dogs at this or any shorter time interval, suggesting that the habituation/dishabituation response of dogs during object play is quantitatively different to that seen in cats (Hall et al., 2002). However, since play with toy 1.1 took up almost the whole of the 30s available, it is unlikely that a small post-inhibitory rebound would have been detectable when toy 2 was presented.

The motivation behind play is likely to be a contributing factor in the dishabituation response. In cats, object play appears to be a form of redirected hunting behaviour, leading to dishabituation that reaches a greater level than the initial play interaction (Hall et al., 2002). In contrast, object play in dogs may be an extension of juvenile play, resulting from the neotenisation of dogs through the domestication process (Frank and Frank, 1982; Bradshaw and Brown, 1990). This difference in the possible motivations for play between the domestic cat and the domestic dog may explain the differences observed between the species in their dishabituation response.

7.7.3. Phase 3: The effect of time interval between presentations on habituation

The habituation response of the dogs over short time intervals appears to be insensitive to the time between presentations. From the consistent median of four presentations to habituation for all time intervals of 10 min or less (except 1 min, taking 3 presentations to habituation), dogs seem to have a pattern of habituation that is insensitive to the temporary absence of the stimuli that they are becoming habituated towards, indicating that they remember those precise characteristics for at least 10 minutes. Thompson (2009) suggests, from a review of earlier studies by Harris (1943), Glanzer (1953) and Welker (1961), that 'the more rapid frequency of stimulation, the more rapid and/or more pronounced the habituation'. However, in this study, using shorter durations, this was not found to be the case. Extending the time interval between presentations to 15 minutes or longer, would presumably eventually increase the number of trials to reach the habituation criterion. However, if the time period between each presentation was very long, the dogs may not associate the presentations together as belonging to the same play session, therefore potentially introducing a different motivational basis for the response compared to the shorter time periods. This might also be possible to investigate using distractions (e.g. feeding or social play) during the intervals between re-presentations of the toys.

7.8. Conclusion

It is clear that habituation and dishabituation are common phenomena in the object play of domesticated carnivores. A better understanding of their role within the context of enrichment for kennel housed dogs has the potential to increase the benefits and prolong the effects of enrichments provided, particularly in the case of play objects.

The almost complete dishabituation observed in both these trials when superficially trivial aspects of the toys were changed is consistent with the powerful neophilia of dogs for toys demonstrated by Kaulfuβ and Mills (2008). It also provides additional support for their suggestion that the "fast-mapping" ability claimed by Fischer et al. (2004) for one dog that retrieved novel toys on command can in fact be explained by simple habituation and/or neophilia.

CHAPTER 8: BEHAVIOURAL INDICATORS OF ANTICIPATION AND FRUSTRATION KENNEL HOUSED DOGS

Abstract

The predictability of an impending enrichment may affect the welfare of kennelled dogs. If enrichment is expected but delayed, anticipation may lead to frustration. Understanding the differences between anticipatory and frustration behaviours exhibited in response to a given enrichment could potentially become a very useful tool in the evaluation of welfare of kennel housed dogs, since only the latter should indicate a challenge to welfare. The study reported here aimed to establish behaviours indicative of anticipation and frustration in response to delayed and/or withheld enrichment in order to aid in better understanding of their effects.

An association was built up between the sound of a doorbell and interaction with a person, to induce anticipation of the interaction. Over a five day period the delay between the doorbell and the human interaction was extended from 0s on day 1 to 180s on day 4. This allowed observations to assess changes in behaviour or behavioural intensity as the delay increased. Comparisons were made between the 40s before and after the doorbell (pre3 and post3) to examine anticipatory behaviour patterns. On day 5, the person entered the room with no delay following the doorbell, but ignored the dog to try to induce frustration behaviours (measured as preF and postF).

Overall the occurrence of 'door directed', 'person directed' and stereotypic behaviour were minimal by both the LSE and RH dogs.

In order to determine whether the behaviour of the dogs varied between phases, the two 40s pre bell time periods (pre3 and preF) were compared; RH dogs spent more time 'near' and 'sit/lie' during pre3. All their other behaviours were similar in duration. No differences were observed in the behaviour of the LSE dogs between the 40s intervals pre3 and preF.

To determine differences in behaviour prior to enrichment and when enrichment was delayed, pre3 was compared with post3; no differences were observed in the behaviour of the RH dogs. LSE dogs showed more 'near' behaviour post3 than pre3, whilst all other behavioural categories were not significantly different. Comparing preF and postF, to determine behavioural differences in behaviour prior to enrichment and when enrichment was withheld, no differences were observed in the behaviour of the RH dogs. LSE dogs showed

more 'towards door' behaviour preF than postF, whilst all other behavioural categories were not significantly different.

The trials at both the RH and LSE kennels were unsuccessful in determining whether a switch from anticipation to frustration is shown by a continuous scale of behavioural intensity or distinct shift in behaviours exhibited. Revisions to the methodology at both environments may aid in successfully determining this in future trials. However, the study highlighted that widely used training methods that rely on positive reinforcement may inhibit a dog's expression of frustration behaviour in the manner expected. Although this in itself may not compromise welfare, a dog carer using such methods may need to become aware of more subtle indicators of frustration behaviour in the dog.

8.1. Introduction

Animals often use external cues as a means of evaluating their environment and maintaining an element of predictability, and this is likely to apply to enrichment that is provided for discrete time intervals (Bassett and Buchanan-Smith, 2007). Paradoxically, unpredictability is also often thought of as enriching, by occasionally introducing an element of novelty to the environment (Poole, 1998). The preceding chapters (Chapters 3, 4, 5 and 6) have described behavioural preferences for different types of potential enrichments for kennel housed dogs, including comparisons between types of potential enrichments, both social and physical (Chapter 6). However, the predictability of impending enrichment may affect the welfare of the dogs. If enrichment is expected but delayed, anticipation may give way to frustration.

Beyond the Pavlovian response to food (Pavlov, 1906 cited in Jones and Gosling, 2005), few studies have looked at anticipatory or frustration behaviour in domestic dogs and more specifically in relation to their welfare. Added to this, defining anticipatory and frustration behaviour is problematic. Since they are not generally studied simultaneously, their definitions can overlap.

In one definition, anticipation leads to the determination of impending actions of others from their preceding behaviour (Kubinyi et al., 2003). However, this definition of anticipation does not quantify it in terms of any observed behavioural or emotional response. Anticipation is generally thought of as inducing positive affect; but, anticipation of aversive conditions may lead to a permanent state of fear or anxiety in preparation for the impending stimulus, although predictability and the ability to anticipate still appear preferential to unpredictable aversive stimuli (Bassett and Buchanan-Smith, 2007). In the case of rats (Prokasky, 1956 cited in Bassett and Buchanan-Smith, 2007) and pigeons (Wykoff, 1952 cited in Bassett and Buchanan-Smith, 2007), preference was shown for a predictable feeding routine where they could exhibit anticipatory behaviour rather than an unpredictable routine where no such anticipation was possible.

Anticipatory behaviour in response to Pavlovian conditioning has been proposed as a useful means of assessing welfare (Spruijt et al., 2001). A stimulus initiating an anticipatory response is considered to be an 'incentive stimulus'

(Spruijt et al., 2001). In anthropomorphic terms, eliciting anticipatory behaviour may allow the animal to 'look forward to' the reward (Spruijt et al., 2001). In domestic dogs, social anticipation of human behaviour alters behaviour and improves their cooperative response towards humans (Kubinyi et al., 2003).

Early studies into frustration defined it as 'a hypothetical motivational state that is induced by thwarting, and which is considered to have excitatory effects on behaviour' (Amsel, 1958, 1962 cited in Roper, 1984) although no suggestion was made as to whether such excitatory effects might have a positive or negative effect on welfare. More recent studies into the frustration response have linked it to compromised welfare. A preliminary study in mice suggested that those raised in enriched environments may be predisposed to increased levels of stereotypic behaviour and an increased stress response if the enrichment is subsequently removed, compared to those raised in a barren environment (Latham and Mason, 2010).

Frustration in domestic dogs has been linked to separation anxiety and has been conceived of as a negative response to being left alone (Lund and Jørgensen, 1999). Lund and Jørgensen (1999) suggest that this frustration response is only problematic above a given threshold but do not go on to quantify this threshold beyond the subsequent onset of separation behaviour. It could be argued that if no negative response (such as chewing or tearing objects apart, or vocalising) occurs; that behaviour should only be classified as frustration once the threshold of the behavioural change is reached, therefore defining it as aversive. A similar response (termed anticipation) occurred in stump tailed macaques and escalated to what could be regarded as a frustration response if anticipated feeding was delayed further (Waitt and Buchanan-Smith, 2001).

Understanding the differences between anticipatory and frustration behaviours exhibited in response to a given enrichment is potentially a very useful tool in the evaluation of welfare of kennel housed dogs. If anticipatory behaviour is defined as the pre-threshold behaviour described by Lund and Jørgensen (1999), and frustration behaviour the behaviour observed after the threshold is reached, then the threshold could be considered the point that certain negative behaviours are first exhibited. Lund and Jørgensen's (1999) study into separation anxiety places the threshold at the point that mild separation behaviours were observed, including displacement activities such as object play and predatory behaviour. This was then considered to escalate in severity through arousal behaviour (barking) and fear behaviour (e.g. salivating, elimination and escape attempts) to destructive behaviour (e.g. chewing and tearing apart) (Lund and Jørgensen, 1999). This would suggest a measureable sliding scale of changes in behaviour or intensity of predictor behaviours that could be used to quantify welfare. Providing kennel housed dogs with the opportunity to predict the arrival of a positive stimulus might provide an element of control in an otherwise potentially unpredictable, unfamiliar and stressful environment. However, if the behavioural response suggests frustration, the delay of enrichment may be detrimental to the welfare of the dogs. The study reported here aimed to establish predictive behaviours of anticipation and frustration in response to delayed and/or withheld enrichment in order to aid in better understanding their effects.

Two populations were studied: dogs in long stay enriched (LSE) kennels (N=12; two breeds), born on site or brought in at approximately 9 weeks old; dogs in rehoming (RH) kennels (N=11) entering the kennel as adults.

8.2. Methodology

8.2.1. Study site

As with the 'preferences for different toy types and presentations in kennel housed dogs' study (Chapter 3), this trial was undertaken at the residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE), and the rehoming kennels at Dogs Trust, Salisbury (DT) (RH dogs). During this trial, the set up and husbandry routines carried out at the two sites were the same as during the previous trial. More general background information on the study sites, husbandry routines and study subjects is given in Chapter 2.

For the LSE dogs, the trial was undertaken in a meeting room on a dog housing area (approximately 4.2x4.0m; Plate 8.1). The dogs were acclimatised to this room prior to the trial as part of their daily walks. At the RH kennels, the trial was carried out in, a relatively quiet, enclosed barn (12.5m x 10.3m, Plate 8.2) away from the main kennel block.

Plate 8.1. The meeting room used for the trial at the LSE kennels.

Plate 8.2. The barn used for the trial at the RH kennels.

8.2.2. Study subjects

At the LSE kennels, 12 adult (1-8 years) (5 male, 7 female; 11 neutered) dogs were randomly chosen from the two breeds available and considered suitable for the trial; Labrador Retriever (N=6) and Miniature Schnauzer (N=6). All dogs had been born on site or brought in at approximately 9 weeks of age. The dogs had all received the same regime of socialisation and enrichment.

Adult (1-8 years) dogs (5 male, 6 female; all neutered) were randomly chosen from those housed at the RH kennels at the time of each trial (N=11). Dogs were excluded from the trial if they were considered by the kennel staff to be nervous of unknown people or aggressive.

Due to the limited number of suitable trial dogs housed at the LSE kennels, two dogs had been used on the 'toys trial' (Chapter 3), one dog was on the 'familiarity of human contact trial' (Chapter 4), one on 'familiarity of dog contact trial' (Chapter 5), and three dogs had been used on the 'choice test' trial (Chapter 6). Five dogs had been used on the 'habituation' trial, whilst eight dogs had not previously been used for any studies reported here.

8.2.3. Procedure: LSE dogs

Object orientated human interaction with a soft (squeaky) toy (Chubleez, UK) (Plate 8.3) was used as the enrichment during this trial since the soft toy (teddy) was found to be the most appealing toy during short term preference tests in terms of duration of interaction and latency to interact (Chapter 2). Pre-trial training (see next section) was carried out during the week preceding the trial in order to create a strong association between the doorbell and enrichment.

Plate 8.3. The soft squeaky toy presented to the LSE dogs as part of the object orientated human interaction.

Pre-trial training

One week prior to starting the trial, the dogs were trained to associate the sound of a doorbell with the presentation of enrichment (10s object orientated human interaction).

Immediately following the sounding of the doorbell, the experimenter entered the room and attempted to interact and play with the dog using a soft toy, for 10s. The experimenter remained the same throughout the trial (a 27 year old female who was unfamiliar to the dogs at the start of the trial). This was repeated for each dog until the dog showed signs of having learned the association; orientation or movement towards the door on hearing the bell.

As well as recording behavioural data for the LSE dogs, it was intended that the Labrador Retrievers would be fitted with heart rate monitors in order to correlate behaviour with heart rate parameters throughout the trial. However, during the pre-trial training, the heart rate monitors did not give a clear or consistent output when the dogs were moving; therefore, this element of the trial was removed.

Trial

The trial was carried out over five consecutive days once an association had been built between the doorbell and interaction with a person. This aimed to induce anticipation of the interaction, and therefore for the dog to exhibit anticipatory behaviour. Over the five day period, the aim was to increase the delay between the doorbell and the human interaction from 0s on day 1 to three minutes on day 4. This allowed observations to assess changes in behaviour or behavioural intensity as the delay increased. In between each delay phase, a 'no delay' phase was carried out to reinforce the association between the doorbell and human contact. On day 5, the person entered the room with no delay following the doorbell, but ignored the dog. This aimed to induce frustration behaviours in the dogs.

Day 1

Morning session 'no delay' phase

The dog was taken to the trial area, and left in the room for a random time period between 40s and two minutes. This allowed the dog to settle in the room and reduce any general anticipation of a person entering the room following a fixed time interval. After this time the doorbell was sounded. The experimenter (initially unfamiliar) immediately entered the room and interacted with the dog for 10s using the soft toy (as in pre-trial training). The experimenter then removed the toy and left the room. This was repeated a further three times to reinforce the association (Table 8.1).

Afternoon session 'no delay' phase

The dog was taken to the trial area and underwent four sessions of 'no delay' interaction, as per the morning session to act to reinforce the association between the doorbell and the enrichment (Table 8.1).

Day 2

Morning session: 'one minute' phase

The dog was taken to the trial area, and left in the room for a random time period between 40s and two minutes. After this time the doorbell was sounded. The experimenter immediately entered the room and interacted with the dog for 10s using the soft squeaky toy. The then removed the toy and left the room. After a second random interval of between 40s and two minutes the doorbell was sounded, 30s later the experimenter entered the room and interacted with the dog for 10s using the soft squeaky toy. The experimenter then removed the toy and left the room. This was then repeated with no delay between the doorbell and enrichment and finally repeated with a one minute delay between the doorbell and enrichment (Table 8.1).

Afternoon session: 'no delay' phase

The dog was taken to the trial area and given four sessions of 'no delay' interaction, as per day 1 to maintain the association (Table 8.1).

Day 3

Morning session: 'two minute' phase

The dog was taken to the trial area, and left in the room for a random time period between 40s and two minutes. After this time the doorbell was sounded. The experimenter immediately entered the room and interacted with the dog for 10s using the soft squeaky toy (as in pre-trial training). The experimenter then removed the toy and left the room.

After a second random interval of between 40s and two minutes the doorbell was sounded, one minute later the experimenter entered the room and interacted with the dog for 10s using the soft squeaky toy. The experimenter then removed the toy and left the room. This was then repeated with no delay between the doorbell and enrichment and finally repeated with a two minute delay between the doorbell and enrichment (Table 8.1).

Afternoon session: 'no delay' phase

The dog was taken to the trial area and given four sessions of 'no delay' interaction, as per day 1 to maintain the association (Table 8.1).

Day 4

Morning session: '3 minute' phase

The dog was taken to the trial area, and left in the room for a random time period between 40s and two minutes. After this time the doorbell was sounded. The experimenter immediately entered the room and interacted with the dog for 10s using the soft squeaky toy (as in pre-trial training). The experimenter then removed the toy and left the room.

After a second random interval of between 40s and two minutes the doorbell was sounded, two minutes later the experimenter entered the room and interacted with the dog for 10s using the soft squeaky toy. The experimenter then removed the toy and left the room. This was then repeated with no delay between the doorbell and enrichment and finally repeated with a three minute delay between the doorbell and enrichment (Table 8.1).

Afternoon session: 'no delay' phase

The dog was taken to the trial area and given 4 sessions of 'no delay' interaction, as per day 1 to maintain the association (Table 8.1).

Day 5

Morning session: 'frustration' phase

The dog was taken to the trial area, and left in the room for between 40s and two minutes. After this time a doorbell was sounded. The experimenter immediately entered the room, stood facing the wall with folded arms holding the toy for a four minute period, making no eye contact with the dog. The experimenter then left the room, signalling the end of the trial (Table 8.1).

Table 8.1. The time delay between doorbell sounding and presentation of object orientated interaction.

Day		Phase	Delay interval (s)			
			Presentation 1	Presentation 2	Presentation 3	Presentation 4
1	am	No delay	0	0	0	0
	pm	No delay	0	0	0	0
2	am	1 minute	0	30	0	60
	pm	No delay	0	0	0	0
3	am	2 minutes	0	60	0	120
	pm	No delay	0	0	0	0
4	am	3 minutes	0	120	0	180
	pm	No delay	0	0	0	0
5	am	Frustration	No presentation of object orientation interaction			

8.2.4. Procedure: RH dogs

The RH dogs underwent the same procedure as the LSE dogs (Table 8.1). Minor changes were made to the methodology since the rehoming practices at the centre placed time restrictions on the trial length. To avoid losing large numbers of subjects after the pre-trial training, or conversely compromising rehoming success (see Section 2.3.1), the pre-trial training element was removed from the trial. For the RH dogs, the toy element was also removed to increase the numbers of dogs available for the trial, as the reaction of many of the dogs when a toy was repeatedly removed during interaction was unknown, and could potentially include aggression. This limited the interaction following the doorbell to human contact rather than object orientated human contact. However, since the dogs received minimal daily interaction (see Section 2.1.1), this was considered sufficient as a reward for the dogs to anticipate.

8.2.5. Data recording

At both the LSE and RH kennels, cameras were mounted on the ceiling of the room in order to remotely record the dogs' behaviour during the trial.

Data were then analysed using the Observer 5.0 (Noldus Information Technology, Nijmegen). Continuous observation of the behaviour of the dogs was observed for 40s immediately prior to the bell cue at the three minute delay (pre3) and immediately after the bell cue at the 3 minutes delay (post3). Behaviour was also analysed for 40s immediately prior to the bell cue at the frustration phase (preF) and 40s after the bell cue at the frustration phase (postF).

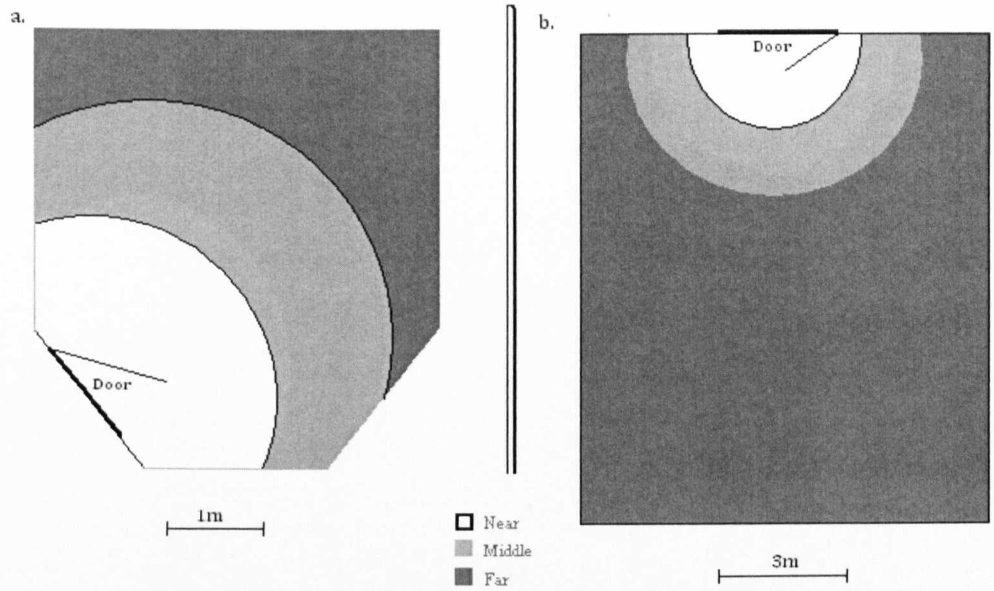
Behaviours were selected for analysis which were considered to indicate anticipation or frustration behaviour (such as door directed, person directed and stereotypic behaviour) (Lund and Jørgensen, 1999; Horwitz et al., 2002; Latham and Mason, 2010; Mills et al., 2010) when compared to baseline 'normal' behaviour in the room (Table 8.2). These behaviours were also considered to be mutually exclusive within each behavioural category.

Table 8.2. Ethogram of behavioural categories pre and post doorbell. Behaviours within each behavioural category were considered to be mutually exclusive.

Behavioural Category	Behaviour	Description
Position	Standing	All four limbs straight and in contact with the floor
	Walking	Slow gait in a standing posture
	Sitting	Hind quarters and all four limbs in contact with the floor
	Lying	Dog's hind quarters and abdomen in contact with the floor
Distance from door	Near	See plate 8.4
	Middle	See plate 8.4
Orientation	Towards door	Head facing towards the door of the room
Tail position	Tail wagging	Tail moving continuously from side to side
Door directed behaviour	Door directed	Jumping up at, scratching, sniffing, pawing the door
Person directed behaviour	Person directed (only for postF)	Jumping up at, sit or lie next to, sniffing the person
Stereotypic behaviour	Stereotypies	Repetitive, apparently functionless behaviour (e.g. pacing, circling)

Vocalisations could not be recorded as the cameras used at the LSE kennels did not detect sound and at the RH kennels no vocalisations were heard. So behaviours exhibited, duration of behaviours and location of the dog were recorded.

Plate 8.4. The rooms used for the trial at (a) LSE and (b) RH kennels. Shading defines the approximate areas used for 'near', 'middle' and 'far' positions from the door.



8.2.6. Statistical analysis

Statistics were calculated using SPSS 14.0 (SPSS Inc, Chicago). Data were first tested for normality. Since none of the data were found to be normally distributed, hypotheses were examined using non-parametric tests.

A Spearman's rank correlation was carried out on the difference in duration between the 40s pre (pre3) and 40s post (post3) doorbell during the three minute delay on day 4, in each behavioural category for the LSE dogs. This was used to determine whether analysis was necessary for all the behavioural categories chosen, or whether changes in some behaviours were highly correlated and could be excluded from further analysis.

For both the RH and LSE environments, a Wilcoxon test was used to compare the durations in each behavioural category before the 3 min bell (pre3) compared to before the frustration bell (preF) to determine whether the behaviour of the dogs varied between phases.

Comparisons were also made between the duration of each behavioural category for pre and post comparisons at the three minute (pre3 and post3) interval and at the frustration (preF and postF) interval using Wilcoxon tests for the RH and LSE populations.

'Door directed', 'person directed' and stereotypic behaviours were rare and so were compared using descriptive statistics.

8.3. Results

8.3.1. Behavioural categories

Following the division of behavioural categories, 'standing' was removed from further analysis as it was highly negatively correlated (Spearman's rho=-0.96, P<0.001) with 'walking' when comparing pre3 and post3 for LSE dogs. 'Near' and 'middle' also showed a high negative correlation (Spearman's rho=-0.87, P<0.001) and so 'middle' was removed, as 'near' was more likely to be indicative of anticipatory behaviour of the dog near to the door. 'Tail wagging' was not analysed since its occurrence appeared to be associated with breed or individual rather than being indicative of anticipatory behaviour.

Sitting accounted for less than 10% of behaviour and so sitting and lying were combined to create 'sit/lie'. 'Door directed' behaviours and 'person' directed behaviours were also analysed. Although 'stereotypic behaviour' was not observed during the pre3 and post3 time periods analysed for the LSE dogs, it was retained as one of the behavioural categories to establish whether stereotypic behaviour was present during the preF and post F periods or at the RH kennels This resulted in seven behaviourally distinct categories for further analysis (Table 8.3).

Table 8.3. Ethogram of revised behavioural categories for further analysis. Behaviours within the same behavioural category were considered to be mutually exclusive.

Behavioural category	Behaviour	Description
Position	Walking	Slow gait in standing posture
	Sit/lie	Hind quarters in contact with the floor
Distance from door	Near	See plate 8.2
	Towards door	Head facing towards the door of the room
Door directed behaviour	Door directed	Jumping up at, scratching, sniffing, pawing the door
Person directed behaviour	Person directed (only for postF)	Jumping up at, sit or lie next to, sniffing the person
Stereotypic behaviour	Stereotypies	Repetitive, apparently functionless behaviour (e.g. pacing, circling)

8.3.2. Pre-bell comparisons

RH dogs spent more time 'near' and 'sit/lie' pre3 than at preF. All other behaviours were equal between the two pre bell time periods (pre3 and preF) (Table 8.4 and Figure 8.1a).

No differences were observed in the behaviour of the LSE dogs at the 40s interval pre3 and preF (Table 8.4 and Figure 8.1b).

Table 8.4. The Z statistic and P value from multiple Wilcoxon tests during pre bell comparisons for 3min (pre3) and frustration (preF) phases by the 11 RH and 12 LSE dogs. P values followed by * were significantly different at $P<0.05$.

Behavioural Category	Pre3 vs. PreF	
	RH dogs	LSE dogs
Walking	1.68, 0.09	0.356, 0.72
Sit/lie	2.20, 0.03*	0.447, 0.66
Near	2.50, 0.01*	1.27, 0.20
Towards door	0.533, 0.59	1.65, 0.10
Door behaviour	1.34, 0.18	1.18, 0.24

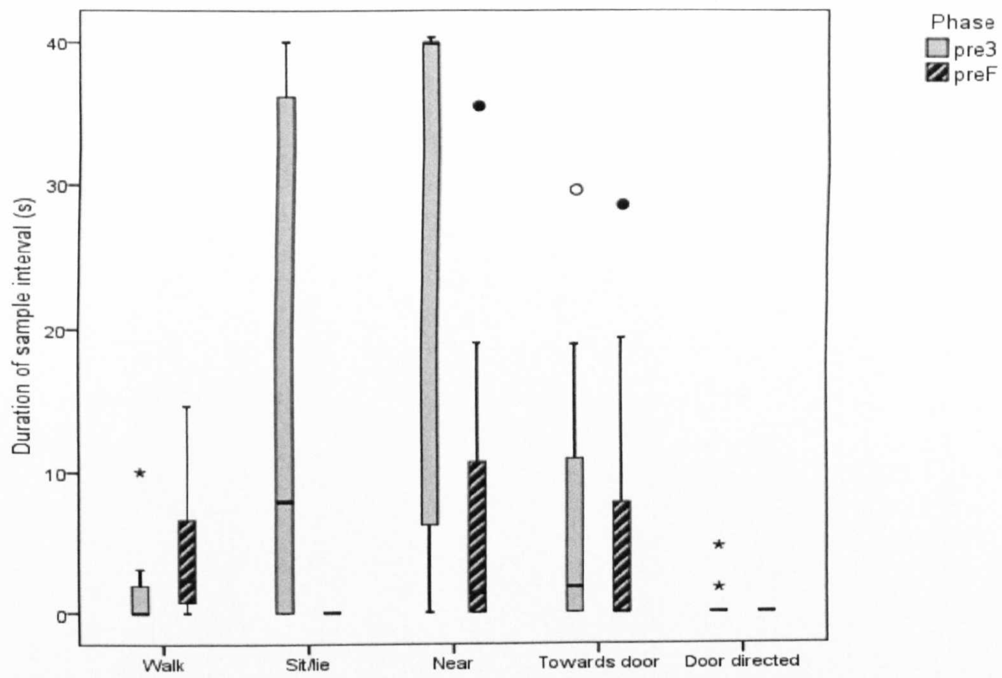


Figure 8.1a. RH dogs

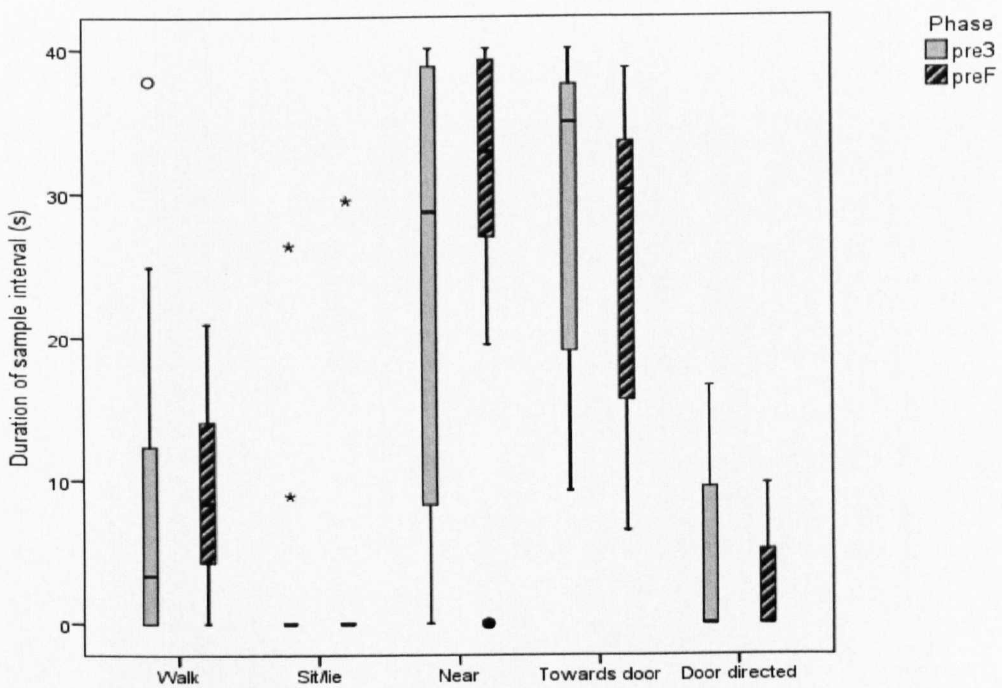


Figure 8.1b. LSE dogs

Figure 8.1. Boxplots of duration (seconds, out of a maximum of 40s) in each behavioural category during pre bell comparisons for 3 min (pre3) and frustration (preF) phases by the (a) 11 RH dogs and (b) 12 LSE dogs. No stereotypic behaviour was observed during these time periods. See Figure 4.1 (Chapter 4) for description of boxplot characteristics.

8.3.3. Three minute delay comparisons

No differences were observed in the behaviour of the RH dogs when comparing the 40s interval pre3 and post3 (Table 8.5).

LSE dogs showed more 'near' behaviour post3 than pre3, whilst all other behavioural categories were not significantly different (Table 8.5).

Table 8.5. The Z statistic and P value from multiple Wilcoxon tests for pre and post bell comparisons during the 3 min bell phase by the 11 RH and 12 LSE focal dogs. P values followed by * were significantly different at P<0.05.

Behavioural Category	Pre3 vs. Post3	
	RH dogs	LSE dogs
Walk	1.16, 0.25	0.445, 0.66
Sit/lie	0.734, 0.46	0.447, 0.66
Near	0.631, 0.53	2.19, 0.028*
Towards door	0.889, 0.37	1.49, 0.14
Door behaviour	0.447, 0.66	0.734, 0.46

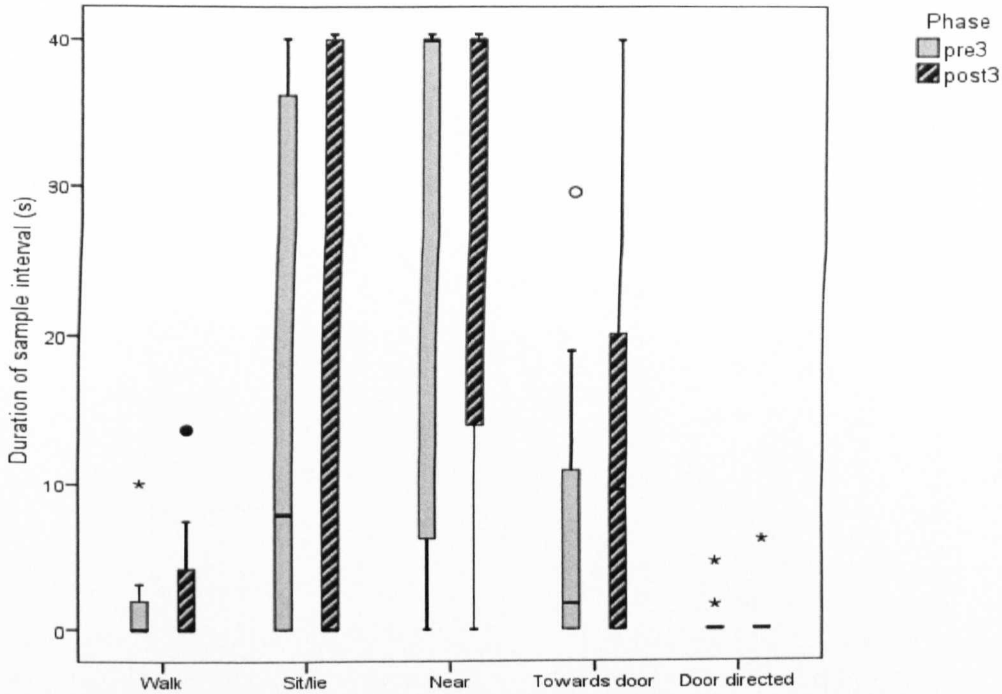


Figure 8.2a. RH dogs

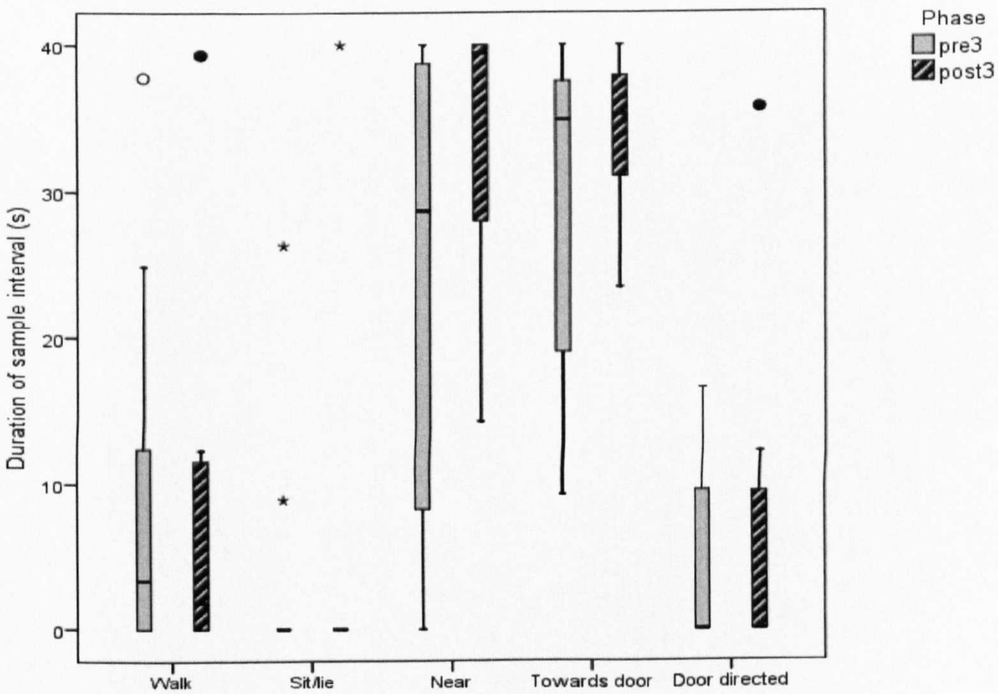


Figure 8.2b. LSE dogs

Figure 8.2. Boxplots of duration (seconds, out of a maximum of 40s) in each behavioural category during pre (pre3) and post (post3) bell behaviours for the three minute phase by the (a) 11 RH dogs and (b) 12 LSE dogs. No stereotypic behaviour was observed during the time periods. See Figure 4.1 (Chapter 4) for description of boxplot characteristics.

8.3.4. Frustration phase comparisons

No differences were observed in the behaviour of the RH dogs when comparing the 40s interval preF and postF (Table 8.6) (Figure 8.3).

LSE dogs showed more 'towards door' behaviour preF than postF, whilst all other behavioural categories were not significantly different (Table 8.6) (Figure 8.3).

Table 8.6. The Z statistic and P value from multiple Wilcoxon tests for pre and post bell comparisons during the frustration phase by the 11 RH and 12 LSE focal dogs. P values followed by * were significantly different at P<0.05.

Behavioural Category	PreF vs. PostF	
	RH dogs	LSE dogs
Walking	1.68, 0.93	1.29, 0.20
Sit/lie	1.34, 0.18	1.83, 0.07
Near	0.28, 0.78	0.255, 0.80
Towards door	0.74, 0.46	2.2, 0.028*
Door behaviour	0.00, 1.0	1.2, 0.23

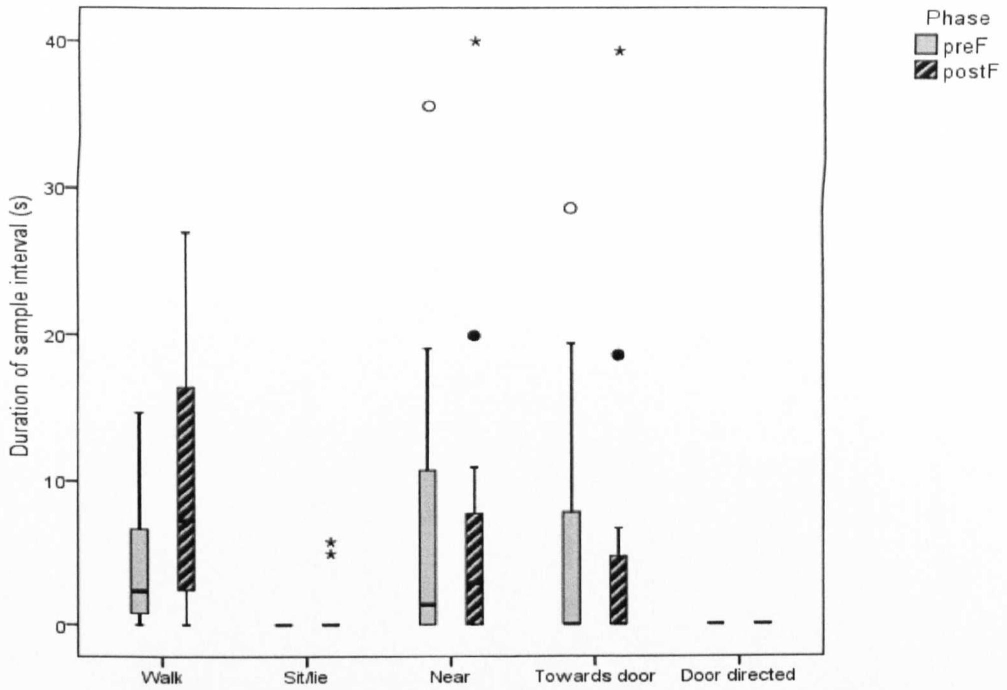


Figure 8.3a. RH dogs

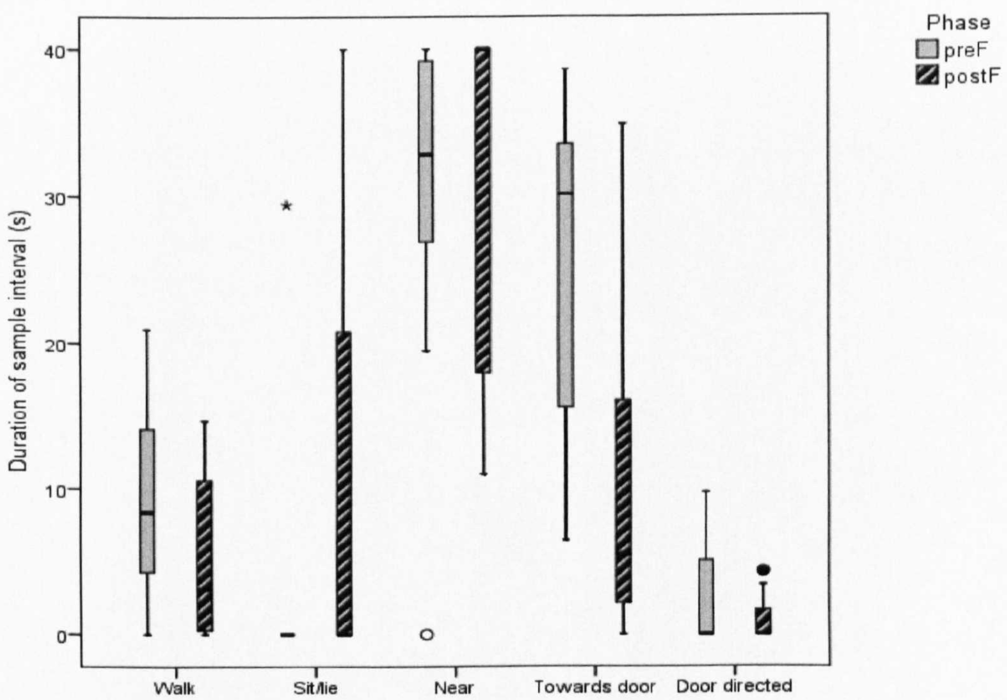


Figure 8.3b. LSE dogs

Figure 8.3. Boxplots of duration (seconds, out of a maximum of 40s) in each behavioural category during pre (preF) and post (postF) bell behaviours during the frustration phase by the (a) 11 RH dogs and (b) 12 LSE dogs. No stereotypic behaviour was observed during the time periods. See Figure 4.1 for description of boxplot characteristics.

8.3.5. 'Door directed', 'person directed' and stereotypic behaviour

Overall the occurrence of 'door directed', 'person directed' and stereotypic behaviour were minimal by both the LSE and RH dogs. No stereotypic behaviour was recorded at either the LSE or RH environment during the trials. 'Door directed' behaviour was analysed from the pre3 and post3 (Figure 8.2) and preF and postF (Figure 8.3) periods as the behaviour could be observed throughout the trial. In all cases, observations of 'door directed' behaviour were low.

'Person directed behaviours' could only be observed during the 'post' time periods when the person was in the room. These behaviours were categorised as 'person directed' behaviours (jumping up at and sniffing) and 'sit/lie next to' in order to distinguish between active and passive behaviours (Figure 8.4). However, their occurrence at both the RH and LSE environments during the 40s time period was low, particularly for the active 'person directed' behaviours.

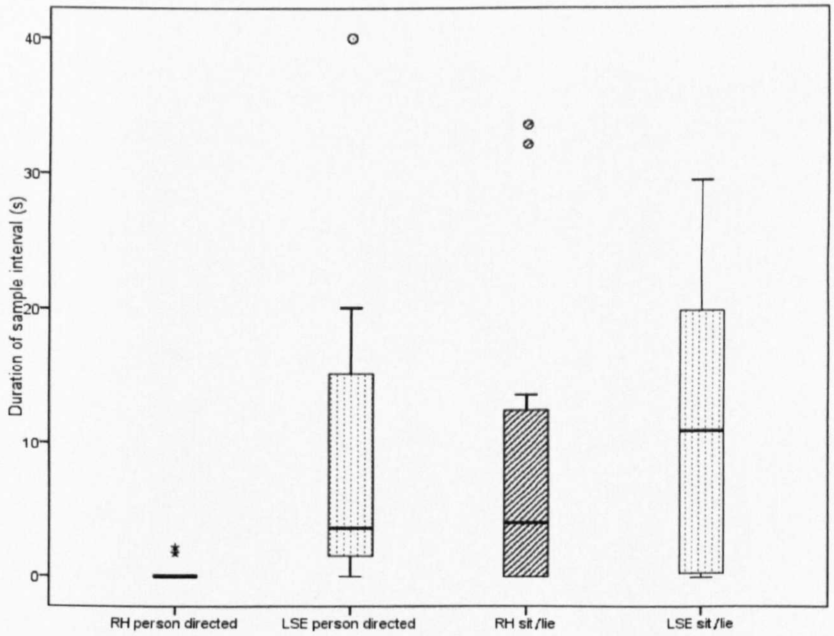


Figure 8.4. Boxplots of average duration (seconds, out of a maximum of 40s) of 'person directed' behaviour during pre (preF) and post (postF) bell interactions combined during the frustration phase by the (a) 11 RH dogs and (b) 12 LSE dogs. "sit/lie" indicates behaviour near to the person, "person directed" behaviour indicates attempted interaction with the person. See Figure 4.1 for description of boxplot characteristics.

8.4. Discussion

8.4.1. Acclimatisation

The lack of difference in behavioural response by the LSE dogs prior to the 3 min bell on day 4 (pre3), compared to prior to the frustration delay bell on day 5 (preF), suggests that the pre-trial training week had allowed the LSE dogs to acclimatise to the trial room. This consequently affected their response to the trial compared to the RH dogs that did not have this period. The LSE dogs appear to be comfortable to explore the room, maintaining low levels of 'sit/lie' and some 'walk' behaviour throughout the 40s period analysed. However, the high levels of 'near' and 'to door' behaviour suggests that the dogs maintained an expectation of being removed from the room.

Over the course of the trial week, the RH dogs appeared to become more acclimatised to the room, shown by a reduction in 'near' and 'sit/lie' from prior to the 3 min bell on day 4 compared to prior to the frustration delay bell on day 5, suggesting a reduced desire to be removed from the room.

8.4.2. Association

Having received a week of pre-trial training, the LSE dogs' increase in 'near' behaviour post3 than pre3 is indicative of a strong association between the bell and the reward. Coupled with this, 'to door' behaviour appears to be an anticipatory response of a person entering the room since it occurred more often in preF compared to postF.

Given the lack of difference between pre3 with post3, and preF with postF behaviour of the RH dogs, it is unlikely that many of the dogs had established an association between the bell and the reward of human contact. Human contact did, however, appeared to be sufficiently rewarding since they were keen to interact when the person entered the room, despite having a poor understanding of the association, confirming the dogs' desire for human contact, observed in Chapter 4 (Wells, 2004b; Coppola et al., 2006).

8.4.3. Anticipatory behaviours

Behaviours that were presumed to indicate anticipation behaviour, such as 'near', 'door behaviour' and 'towards door' became problematic in indicating anticipatory behaviour when the reward was delayed, because, on the whole were relatively low or showed wide variation between individuals. Since anticipatory behaviours were present in both pre and post bell time periods, it is difficult to determine how much of this behaviour is simply a result of the increasing length of time the dog is left in the trial room. It may be that more subtle behavioural changes need to be measured or the use of a higher value resource as a reward.

Food rewards are often used when measuring anticipatory behaviour of a variety of species including mink (Vinke et al., 2004) rats and cats (Van den Bos et al., 2003) and their success as such may be attributed to their high value to the animals. Play deprived and socially isolated animals also show increased anticipatory behaviour for food (Morgan and Einon, 1975; Ahmed et al., 1995; Van den Berg et al., 2000; Van den Berg, 1999 cited in Spruijt et al., 2001). It is also worth considering that anticipatory behaviours (and therefore possibly frustration behaviours) showed species differences, consistent with their 'natural' behaviour when comparing anticipatory behaviour in rats and cats in relation to anticipation of a food reward (Van den Bos et al., 2003). Anticipatory behaviour may therefore differ between species, for example those with different foraging strategies, such as carnivores and herbivores. It is also worth noting that since frustration behaviour in mice varies between individuals based on life history (Latham and Mason, 2010), it may be that anticipatory behaviour may also be affected in the same way. Therefore, generalisations of anticipatory and frustration behaviours across species and between environments should be approached with caution and perhaps assessed on a species specific and life history basis.

8.4.4. Frustration behaviours

Frustration behaviours were considered as behaviours likely to be indicative of a thwarted motivation and consequently compromised welfare in the dog. Stereotypic behaviours and door directed behaviours (jumping up at, scratching, sniffing at, pawing) were chosen, as they are often cited in the literature as being indicative of compromised welfare and frustration (Lund and Jørgensen, 1999; Latham and Mason, 2010). Person directed behaviour ('jumping up at', 'sit/lie next to' and sniffing') was chosen as an active response to gain attention from the person and therefore potentially frustrating to the dog when no response was given. The low levels of frustration observed in both the LSE and RH kennel environments could be indicative of one of two things. Firstly, the situation the dogs were placed in may not have been sufficiently frustrating to induce a frustration response in the dogs. Secondly, the measured behaviours and experimental setup may not have been effective for measuring frustration. As previously mentioned, it appears that the RH dogs did not have a sufficient association between the bell and the anticipation of human contact, therefore the protocol was unlikely to induce the expected frustration behaviour in these dogs.

The slightly higher occurrence of 'person directed' and 'sit/lie' behaviour exhibited by the LSE dogs during the postF phase suggests some level of anticipation or frustration behaviour. However, these consistently low levels suggest that this response is minimal. This may be a result of the training techniques used, since general observations of the dogs during the trial suggests that the dogs exhibited a range of behaviours towards the person in order to gain their attention, consistent with Kubyini et al.'s (2003) theory that dogs use a trial and error strategy under these circumstances. Dogs that have been trained, such as the LSE dogs, appear to have better problem solving abilities than untrained dogs (Marshall-Pescini et al., 2008), whilst clicker training (a positive reinforcement training technique used in training all the LSE dogs) also appeared to increase problem solving abilities in dogs compared to other training techniques (Osthaus, 2003 cited in Marshall-Pescini et al., 2008). Added to this, only one LSE dog jumped up at the person, a behaviour that would suggest frustration, but this may simply reflect that this behaviour is one that the dogs had been trained not to exhibit.

8.4.5. Anticipation vs. frustration: A sliding scale or distinct behaviours?

Since comparisons of person directed frustration behaviours could only be carried out when the person was present in the room, the trial was limited in its usefulness at measuring frustration behaviours. The method trialled in this chapter remains valid, but might produce clearer results under different experimental conditions. Low levels of 'door behaviour' also reduced the capacity for comparisons between frustration responses. Comparisons between anticipatory and frustration behaviour therefore warrant further investigation. Removal of enrichment is considered to be frustrating to the individual when that enrichment is expected as opposed to those individuals with no prior experience of the enrichment (Latham and Mason, 2010). However, the trial design would require substantial modification in order to induce more distinct anticipatory and frustration behaviours. This may also result in an alteration of the measured behaviours. Considerations should also be made for the type of training that the dogs have undergone, since, for the LSE dogs, the trial does suggest that the frustration response (such as jumping up, pawing or scratching the door) may have been suppressed by the training to produce a 'well behaved' dog. The lack of association present in the RH dogs, alongside their alteration in behaviour as the trial progressed highlights the need for the pre-trial training that was possible with the LSE dogs. This not only allows the dogs to acclimatise to the trial area, but also allows a stronger association to be built between the bell and the reward of human contact that is necessary for the trial.

It may also be necessary to link the observed behaviours to physiological measures of stress such as cortisol levels or heart rate in order to validate the behavioural response against a qualitative measure and determine whether the behaviour is linked to changes in physiological states and stress responses to an undesired level (Coppola et al., 2006). However, urinary cortisol levels are affected by length of stay in rehoming kennels (Stephen and Ledger, 2006) and prior experience of kennels (Hiby et al., 2006) and heart rate is considered less specific than behavioural responses when assessing the reaction of dogs to potentially aversive stimuli (Beerda et al., 1998). Following successful use of salivary cortisol measurements in pigs when offered environmental enrichment (De Jong et al., 2000), the use of salivary cortisol may be a feasible physiological measure alongside behavioural measures in kennel housed dogs. However, in order to accurately measure salivary cortisol, a number of difficulties must be overcome, such as the effect of circadian rhythms, uncontrollable influences such as people and dogs (Coppola et al., 2006) and contamination from food during saliva collection (Dreschel and Granger, 2009).

8.5. Conclusion

The trials at both the RH and LSE kennels were unsuccessful in determining whether the switch from anticipation to frustration is shown by a sliding scale of behavioural intensity or distinct shift in behaviours exhibited. However, it did highlight the importance of the pre-trial training in building up the association between the door-bell and the presentation of the enrichment. Revisions to the methodology at both environments may aid in successfully determining this in future trials. The study did highlighted that widely used training methods that rely on positive reinforcement may inhibit a dog's expression of frustration behaviour in the expected manner. Although this in itself may not compromise welfare, a dog carer using such methods may need to be aware of more subtle indicators of frustration behaviour in the dog.

CHAPTER 9: GENERAL DISCUSSION

9.1. Chapter outline

The aim of this thesis was to determine how potential enrichments are utilised when they are first presented to kennel housed dogs, providing an indication of which would be candidates for the provision of longer term enrichment. I hypothesised that 'the extent to which interaction with potential enrichments occurs would be strongly influenced by the type of enrichment offered'. This was addressed in Chapters 3, 4 and 5, where comparisons were made within the potential enrichment categories of inanimate, conspecific social and human social, and subsequently between these three categories in Chapter 6.

It was possible to explore the motivations underlying choice of potential enrichments to optimise the longevity of those potential enrichments to be offered in the future (Chapter 7) and the effects of expectation of enrichment provision on behaviour and potentially on welfare during delayed or denied enrichment (Chapter 8).

Where possible, two contrasting kennel populations were studied, to provide a preliminary indication of the variations in preference that may occur due to differences in dogs' experiences prior to and during kennelling. Although these environments could not be standardised between trials, comparisons have allowed an insight into the effects of past experience and current environment on the degree of interest in candidate enrichments offered. This will be explored further in Sections 9.5 and 9.6. Breed differences were also analysed where possible, to determine whether enrichment requires a breed specific focus or can be generalised to dogs of different types (Section 9.16).

Section 9.2 summarises the key findings of each trial to address the aim of the study. Sections 9.4, 9.6 and 9.7 then details the applications of these findings in terms of potential enrichment provision and their use in kennel environments. These are also related back to the underlying motivations for object orientated play and social interaction (Section 9.8 and 9.9). Other key discussion points arising from the experimental trials are discussed separately in Sections 9.10 to 9.15. The shortcomings and potential methodological improvements of the studies are discussed in Section 9.16. Finally, the key findings are reviewed in terms of potential future research (Section 9.17).

9.2. Summary of individual trials

The welfare of kennel housed dogs continues to be a primary concern throughout kennel environments in the UK. For reasons of practicality and hygiene, kennel environments tend to be unstimulating when compared to the domestic environment for which dogs have mainly been selected. Having initially addressed the use of potential enrichments which might reduce this problem, this thesis continued to look at the underlying motivation for engagement with such enrichments and loss of interest in enrichment.

Initial preferences for potential toy enrichments suggested that during solitary interaction, dogs preferred soft squeaky toys that could be manipulated and chewed to give an interactive response (Chapter 3), confirming the idea set out by DeLuca and Kranda (1992) and Hubrecht (1993b; 1995) that dogs prefer chewable toys that make a noise over those which do not. When provided with human social enrichment, unfamiliar people were preferred by the LSE dogs, suggesting a preference for novelty in an environment where human social contact with familiar people is common-place. In contrast, the RH dogs appeared to value any human contact with no preference for familiarity, presumably since, when compared to the LSE dogs, their human contact provision was more limited overall (Chapter 4). During conspecific contact the initial greeting period appeared to be more important to the LSE dogs when paired with an unfamiliar dog; after this period, interaction appeared of more interest with familiar dogs. Breed differences were only evident during the initial greeting period of 0-3 min, with Miniature Schnauzers spending more time closer to both familiar and unfamiliar dogs than the Cocker Spaniels and to some degree the Labrador Retrievers (Chapter 5; conspecific contact could not be measured for the RH dogs). Comparisons between social and physical enrichment (in terms of toys, human contact and conspecific contact) in LSE dogs highlighted a higher level of interest in social contact, be it human or conspecific, than interest in toys. In addition to this, the dogs maintained interest in goings-on outside of the pen, and presumably in being retrieved from an unfamiliar situation (Chapter 6).

During object orientated play, habituation to each object was rapid, but it was possible to induce a dishabituation response following habituation by simply changing a single sensory modality of the toy. So long as habituation to play itself had not occurred, minor changes to the toy offered were sufficient to reinstate play. However, in the short term at least, altering the time interval between presentations of the toy both prior to habitation and after habituation was not found to alter the dishabituation response (Chapter 7). Finally, anticipatory and frustration behaviours were studied, aiming to determine whether these comprise two distinct groups of behaviours or a sliding scale of behavioural intensity from anticipation through to frustration. Although limitations in the methodology did not allow this to be established, it did highlight, for the LSE dogs, that positive reinforcement training techniques may partially inhibit or alter the expression of frustration (Chapter 8).

9.3. Why is measuring candidate enrichment important?

As outlined in Chapter 1 (Section 1.1), provision of enrichment for captive animals is a widely used and accepted method of mitigating the detrimental welfare effects associated with the captive environment. Although long-term effects of enrichment on welfare *per se* were not studied, due to time constraints on dog availability, by looking at potential enrichment use (Chapters 3, 4, 5 and 6), it has been possible to better understand the limitations and potential benefits of environmental enrichment in captive environments.

"Enrichment" is currently used within the literature to cover a wide range of aims (Section 1.1.2). If enrichment is based around improving welfare (Benefiel et al., 2005) and reducing behaviours considered indicative of poor welfare such as stereotypies (Mason et al., 2007), then simply introducing enrichments on the basis that they 'may' work is perhaps counterproductive. The short term measurements of candidate enrichments achieved in this thesis have rapidly and relatively easily allowed uninteresting enrichments to be discarded at an early stage. In addition to this, establishing the motivation behind play and the structure of play may provide an insight into cessation and reinstating of engagement with enrichments.

In practical terms comparisons between social and physical contact and the choice for one potential enrichment type over another, again, gives an insight into the motivations involved, and perhaps areas currently neglected, or areas to prioritise for enrichment provision. It could be construed that offering further or different enrichment opportunities to dogs housed in kennels considered to already provide high levels of enrichment cannot further improve welfare. This case could be argued for the LSE kennels, where, prior to the start of the studies carried out, dogs were already provided with a daily program of enrichment including social contact with conspecifics, human contact and 'toys' (see Chapter 2). However, by continuing to evaluate the type of enrichment offered, it is possible to further improve welfare by providing the optimum type of enrichment for dogs housed within different environments. By better understanding an animal's choice for and behaviour towards enrichments offered, it may be possible to better meet their physical, social and psychological needs and subsequently further improve or avoid a reduction in welfare standards.

9.4. Preference for enrichment

By assessing preference for potential enrichments in the short term, it has been possible to determine the most appealing types of candidate enrichments offered. Considering the types of object enrichment that were found to be most appealing has also provided information on the motivation behind object play in dogs and the effects of the habituation response. Object orientated play behaviour in domestic dogs has often been studied from an interactive viewpoint, observing play during interactions with people or conspecifics (Mitchell and Thompson, 1990; Rooney et al., 2000). This in itself provides a different quality of interaction with the simultaneous provision of social and physical enrichment to maintain interest in interaction, and may be motivated primarily for its social benefits, with the toy acting merely as a focus. Solitary object orientated play is logically, and appears in practice to be, governed much more by the interactive properties of the toy itself. Those toys producing a stimulating response when interacted with, alongside toys which could be chewed, provided the most appeal and longest duration of interaction (Chapter 3). This would suggest a predatory response for toys that squeak and can be chewed. However, a squeaky plastic bone and a soft squeaky teddy, both providing a similar interactive 'squeak' response and a chewable object, differed in their duration of interaction. The preferred soft teddy perhaps retained interest as possessing more of the stimulus qualities of a prey species such as a rabbit, which a feral or wild counterpart may consider as a prey object (Boitani et al., 1995; Coppinger and Schneider, 1995).

9.5. Site differences

Two study sites were used for the trial: the Dogs Trust, Newton Tony, Salisbury (RH) and WALTHAM® Centre for Pet Nutrition (WCPN), Waltham on the Wolds, Leicestershire (LSE). The two sites provided contrasting dog populations in order to explore the effects of prior and current experiences on the effectiveness of candidate enrichments. The RH kennels housed dogs relinquished from domestic environments, during a relatively short transitory period prior to their being rehomed (with some longer stay dogs). Conversely, the LSE environment was comprised of long stay kennels with dogs generally being housed on site from birth to eight years of age. The LSE dogs were provided with high levels of structured enrichment on a daily basis (see Chapter 2). As previously mentioned, the two environments could not be standardised to allow direct comparisons to be made between them and limitations of trial facilities restricted some trials to only be carried out at the LSE kennels. It was possible to undertake the studies looking at 'toy preference' (Chapter 3), the 'familiarity of human contact' (Chapter 4) and 'anticipation and frustration behaviour' (Chapter 8) at both kennel environments.

Where broad comparisons could be made, the studies have highlighted the need to assess kennel environments on an individual basis, or at a minimum to look at the current housing conditions, whether long stay vs. short term kennels, and also breed differences, and levels of environmental enrichment routinely provided, to name but three. However, it also highlighted that some generalisations may be possible across the kennel environments, detailed in Section 9.6.

9.6. General effects of kennel environment

Despite the clear differences that emerged between the two kennel environments studied, it seems feasible to make some generalisations across kennel environments. Although the effects of familiarity on interaction with humans and conspecifics are clearly important, regular physical social contact with both was initiated by most dogs in both environments (Chapter 4, 5 and 6), even though not all comparisons recorded from the LSE dogs could be made for the RH dogs. Comparisons to other kennel environments would be likely to confirm this. For example, laboratory housed dogs instigate human and conspecific contact and interact with physical enrichment such as toys, feeding enrichment and platforms (Hubrecht, 1993b). It is likely that the site differences would become evident in the more subtle differences and choices of the dogs such as the familiarity and toy preference effects observed in this thesis. However, past history must be considered, particularly in the case of social contact observations and the RH dogs, since negative past experiences or poor socialisation may reduce the value of human or conspecific social contact and increase stress in the dog (Scott and Fuller, 1965 cited in Serpell, 1995b; Miklósi, 2008). This supports Head et al.'s (1997) study, suggesting that during an open field test and during human interaction, differences between laboratory and shelter housed dogs were more evident with increased age, and therefore likely to be affected (alongside other factors) by past experience.

9.7. Preference for social over object enrichment

9.7.1. Toy enrichment

The overall low levels of interaction with toys in both environments, suggested that regardless of whether daily enrichment was provided by a structured enrichment programme (LSE) or simply arose from the goings on outside the kennel (RH), the robust toys were not of sufficient interest in either environment to be potentially enriching for the dogs in the longer term. This complements Well's (2004a) findings in rescue centres, where interaction with toys was limited. Interaction levels were increased by providing less robust toys for the RH dogs (Chapter 3.7), (not replicated for the LSE dogs due to ingestion risk). It seems likely, judging by levels of interaction with the soft toy (teddy) when looking at habituation in dogs (Chapter 7), that a similar higher level of toy interaction would have occurred had the LSE dogs been presented with less robust toys.

Although this contrasts with Hubrecht's (1993b) findings, suggesting high toy use by laboratory housed beagles, that study concentrated on group housed beagles and focused on 'toys' that induced feeding rather than play, such as Nylabone chews. This reduces the usefulness of comparisons to the kennel environments studied here.

9.7.2. Social contact

As a social species, the domestic dog would be expected to instigate and maintain social contact. This has been confirmed in the context of both conspecific and human contact (Chapter 4 and 5). During object orientated social play, it has been established that the structure of play is different during human-dog and dog-dog interaction (Rooney et al., 2000). This, alongside the studies carried out here, would suggest that not only the motivation but also the need for social contact is not interchangeable. The behaviours observed during human contact (Chapter 4) were qualitatively different to those observed in conspecific contact (Chapter 5).

Differences between the RH and LSE environments during the provision of human contact provide an insight into the importance of human contact for kennel housed dogs and the effect of environment on this contact. Dogs housed at the RH kennels where human contact was limited appeared to have no preference for a particular type of human contact, if this is measured simply as the degree of social interaction. However, when observing more subtle behaviours, the orientation of the dog would suggest that the dogs were more comfortable with the familiar person, orientating themselves towards them, whereas with unfamiliar person, they preferred to orientate themselves to see out of the kennel. A familiarity effect also affects conspecific contact for the LSE dogs. During conspecific interaction, the initial 'greeting' appears to be more important, with physical contact necessary to obtain olfactory cues regarding the unfamiliar dog (Section 5.4). Although on-lead interaction provides conspecific contact, the off-lead 'greeting' period appears to be of particular importance for unfamiliar dogs in order to signal sufficiently and to move towards or away from the other dog without restriction (Haug, 2008; Mariti et al., 2010; Westgarth et al., 2010). Following this relatively short period, interaction levels dropped with unfamiliar dogs, whilst familiar interaction increased, suggesting the familiar dogs were more comfortable with each others' presence whilst the unfamiliar dogs preferred to explore the field rather than maintain social contact. Since these dogs were well socialised, it may be that the same trial carried out on the RH dogs would produce a different result as their very limited physical conspecific contact and rare off-lead interaction beyond pair housing may increase interest in unfamiliar conspecifics, as was seen with the human contact trials. There may be higher levels of calming and appeasing signals towards the unfamiliar dogs than observed with the LSE dogs (Mariti et al., 2010), but poorly socialised RH dogs may also show higher levels of agonistic behaviour (Orihel and Fraser, 2008).

This motivation to instigate social contact is further confirmed by the behaviour of the dogs during the choice test trial (Chapter 6), with social contact valued more highly than toy interaction. However, somewhat surprisingly, the familiar conspecific contact appeared to be of equal interest as non-interactive unfamiliar human contact. This could suggest that human contact may be of higher value if the human had presented a willingness to interact in the same way that the conspecific was able to. A change in the dogs' behaviour was clearly seen as familiarity altered over three sequential interactions during the human contact trial (Chapter 4). However it is unclear whether this familiarity would be sustained long-term. Increased durations of interaction with unfamiliar people may be necessary to induce a long-term 'remembered' familiarity. In the same way, the time interval over which conspecifics become familiar is unknown. One previous interaction may be sufficient for recognition, but not necessarily familiarity and a concomitant alteration in greeting and interactive behaviour. Recognition of an unfamiliar dog, following one interaction is likely to be necessary to avoid dogs that previously provided an agonistic interaction or to approach dogs that provided positive interactions (Haug, 2008). This is unlikely to be sufficient to alter their behavioural response observed to that seen during off-lead familiar interactions, suggesting a graded change in behaviour as familiarity increases.

The reaction to human contact by shelter dogs is often reported to be affected by the gender of the person (Lore and Eisenberg, 1986; Hennessy et al., 1998; Wells and Hepper, 1999), with dogs overall more likely to approach a female petter, although insufficient volunteers were available to determine this at the RH kennels. No gender effect on the dogs' behaviour was observed for the LSE dogs, highlighting the effect of past experience on enrichment success. In rehoming centres, the increased reluctance of dogs to approach and increased levels of defensive behaviour towards men has been attributed to differences in appearance or body odour (Wells and Hepper, 1999). However, dogs may be more fearful of men due to past experience or the larger proportion of female carers at rehoming centres (reflected in the ratio of male to female RH kennel staff available for the human contact trial (Section 4.2.2)). Despite the male/female imbalance at the LSE kennels the LSE dogs were continually socialised with male carers, office staff and visitors to negate any likely effects of a high female presence or gender differences in the quality of interaction.

9.8. Play structure

Studies into play structure of species other than domestic species (predominantly cats and dogs) are limited (Hall, 1998). Much of the enrichment focus for captive animals is centred around food enrichment, leading to foraging rather than play behaviour (see Young, 2006). Objects introduced as 'play' objects may in fact induce motivational states other than play (Newberry, 1995), removing the opportunity to study play structure. The aim of much of captive animal enrichment, to increase natural behaviours and decrease stereotypic behaviours (Mason et al., 2007) focuses studies away from analysis of play structure.

It has previously been observed by Hall et al. (2002) that the structure of play exhibited by domestic cats relates to a predatory response. Comparing the response of dogs to that of cats during object orientated play suggests a clear difference in the underlying play motivation. Although superficially the response appears to be similar (Section 7.4.1), in terms of the habituation and dishabituation seen, the domestic dogs lacked the level of dishabituation response present in cats, which can induce a level of play over and above that seen with the initial presentation of the first toy (termed disinhibition). However, this response might be replicable in the dog if length of presentation and time interval between presentations were altered. Whilst play behaviour in juvenile carnivores is attributed to a learning process to gain and refine predatory behaviour necessary for survival through prey capture as adults, the neotenisation of the domestic dog may have continued this trait into adulthood (Coppinger and Schneider, 1995; Hall, 1998). Cats retain their hunting ability, whilst the suppression or adaptation (e.g. Greyhounds or Border Collies) of hunting behaviour in dogs as a result of domestication, seen in the behavioural of feral dogs living as scavengers in preference to a predatory lifestyle (Boitani et al., 1995), perhaps explains the differing dishabituation response.

The short length of interaction with any of the toys offered during a 15 minute interaction (Section 3.4), even with toys considered to be of more interest to the dogs as play objects (Section 3.7), would suggest that the structure of play is unique during solitary interaction. When compared to the structure of play during human and conspecific orientated play observed by Rooney (2000), the lack of a play partner and the reluctance to interact with the hanging toys provided suggests that some element of the interactive play is due to the social nature of the play interaction rather than the simple facility to 'tug' against the toy.

9.9. Understanding motivation and habituation to control and reinstate play

The capacity to induce any level of rebound effect and reinstate play behaviour following habituation provides a key factor in stimulating play and thereby providing effective environmental enrichment. While the motivation for play itself remains, it is possible to utilise that play behaviour and to understand and optimise its benefits. Even within a 15 minute duration of presentation, interaction with the toys ceased rapidly, and yet minor changes in the stimulus properties of a higher interest toy presented a sufficient contrast to reinstate interaction with the toy (Chapter 7). What is currently unclear is how minor these changes can be before this effect diminishes, and how long-term the effect is in terms of repeated rotation of toys. Both changes in colour (contrast) and odour cues of the toy were sufficient to implement this response, providing huge potential in reinstating play behaviour for captive animals through short term toy rotation and cleaning rather than any need to permanently change toys. Bayne (2003) suggests that, in the case of non-human primates, the removal and re-presentation of enrichment objects would maintain the interest in the object for longer periods. However, no suggestion is made to altering the sensory characteristics of the enrichment objects.

Since the play structure is likely to be different during solitary interaction compared to object orientated interaction with humans or conspecifics (as discussed in Section 9.8 in the context of Rooney et al.'s (2000) study), it is likely that the habituation response and motivation to interact is different also. The rapid habituation response seen during continued short duration object play is likely to be much longer with human and conspecific presence since these play sessions provide additional social interaction and a constantly changing element to the play whilst the solitary interaction with the toy is limited in its sensory variety once the toy becomes predictable. However, once interactive play with a human partner has been habituated to, play may continue as a solitary interaction since the two are likely to satisfy different needs.

This thesis has enabled observations of three areas of play structure; the motivation to initiate play, which varies considerably depending on the value of the objects offered (Chapter 3); habituation to play, in determining that the cessation of play with a toy is more likely to be habituation to the stimulus properties of the toy rather than habituation to play itself (Chapter 7); and the reinstating of play, further confirming the idea that the habituation was to the object and not to play, and also that minor changes were sufficient, as was seen in cats, to reinstate play (Chapter 7).

Physical enrichments objects such as toys are likely to be of limited interest in the long term since their interactive capacity is limited and play is more of a remnant of a predatory behaviour rather than satisfying a current need. Added to this, they only fulfil one element of the dogs' needs. Enrichment objects which provide food allow interaction and potential play opportunities but also provide nourishment and induce foraging behaviour. Social contact, whether with humans or conspecifics fulfils perhaps a more fundamental and necessary desire for social contact and is therefore more enriching (Chapters 4, 5 and 6).

However, successful object enrichment is advantageous in enriching the environment especially where other forms of enrichment, particularly structured social cannot be offered, whether due to lack of time constraints on staff, risks associated with conspecific contact or a need to monitor intake (in terms of feeding enrichment provision).

9.10. Expectation

An important consideration in the provision of enrichment is to determine whether past provision of enrichment leads to higher expectations of future enrichment and therefore a greater welfare concern if that enrichment is not then provided. Although this was not determined at either of the kennel environments (Chapter 8), the literature suggests that animals housed in barren cages have a lower expectation of enrichment in the future. Mice reared in highly-enriched environments from birth were more likely to suffer from stereotypic behaviours if the enrichment was later withdrawn, compared to mice reared in barren environments. Their motivation to seek enrichment was also greater (Latham and Mason, 2010). This continues to pose the question of whether no enrichment is preferable to intermittent or unpredictable enrichment and would suggest that continued provision of enrichment is far more important for the LSE dogs that have provided with a highly enriching environment form birth, than the RH dogs. This idea may also go some way to explaining the differences in coping ability and mechanism of dogs housed in rehoming centres, depending on their prior experience and subsequent expectation of enrichment.

9.11. Routine and predictability

The need for routine versus the benefits of novelty are continually discussed in the literature, usually from either one viewpoint or the other (see Watters, 2009). As outlined in Chapter 2, dogs housed at both the LSE and RH kennels were subjected to a clear routine in many areas of husbandry, such as feeding times and the presence of carers in the kennel areas. However, timing of other aspects, such as walks and cleaning times, although carried out within a set time period, varied within that time period on a daily basis. Routine is perceived to provide an element of predictability and control of the environment (Watters, 2009), something considered important within the RH kennel environment where the dogs enter an unfamiliar and stressful situation. Some element of routine allows the animal a means of control but no routine could be argued as better for the animals' welfare than a broken one (Waitt and Buchanan-Smith, 2001; Bassett and Buchanan-Smith, 2007). Whilst coping strategies may vary on an individual basis, (Rooney et al., 2007). predictability tends to be favoured to reduce stress (Bassett and Buchanan-Smith, 2007). However, predictability of feeding times in stump tailed macaques increased undesirable behaviours such as self directed behaviours and abnormal behaviours (Waitt and Buchanan-Smith, 2001). It could be argued that the effects of predictability and routine are dependent on the type and value of the enrichment. In broad terms, the literature tends to use anticipatory behaviour as positive (Dudink et al., 2006) and frustration behaviour as negative indicators of welfare (Latham and Mason, 2010), although the two terms are sometimes interchanged.

Two negative aspects of the predictable provision of enrichment could be considered, however. Firstly, it is reliant on the carers to be able to maintain a sufficient element of routine for the animal to allow the predictability to be maintained. Perhaps a compromise would be to provide a conditioned stimulus of impending enrichment, as was given in the form of a doorbell during the anticipation study (Chapter 8). In pigs post weaning, this approach increased interaction with the enrichment (Dudink et al., 2006). In kennel environments this could remove the need for a timetabled enrichment program, whilst allowing the dogs to retain a degree of predictability and control over their environment. However, it would rely on carers having the time to train the dogs to a conditioned stimulus and would therefore be better suited to longer term kennel environments or long stay dogs in rehoming centres. Secondly, the provision of enrichment, as a beneficial measure to mitigate the effects of confinement and reduce stress, is reliant upon novelty to be effective. As discussed in Section 9.9, when no longer novel the objects are likely to cease to be of interest and provide little enrichment (Chapter 7).

When provided with hanging toys (Chapter 3), the RH dogs, although exhibiting exploratory behaviour, often appeared neophobic towards the toys, backing away or avoiding them when they began to swing freely, a behaviour not observed in the LSE dogs. This would suggest they were detrimental to welfare by further increasing stress levels of the dogs. Contact with conspecifics also has the potential to be stressful. Hubrecht et al. (1992) states that 'providing sheltered dogs with increased social (conspecifics) contact may also allow an animal to gain more control over its environment, thereby decreasing the chances of the individual failing to cope with the pressures of confinement'. However, the difference in behaviour towards a known versus unknown conspecific by the LSE dogs suggests that the value of conspecific interaction is dependent on familiarity (Section 9.7). Conspecific contact, particularly when unfamiliar, as is commonly the case for dogs housed in rescue centres, may simply increase stress levels in an already novel and stressful environment.

Potential enrichment that also provides a sense of novelty may be successful as enrichment if the individual animal is able to gain some control over it. A toy provided on the floor can be investigated or avoided, whilst a hanging toy that is gently nudged by the dog may unpredictably swing back in an uncontrollable manner. This may also provide some insight into why certain robust hanging toys were of marginally more interest. The boomer ball created a pendulum effect when investigated whilst the ragger could be held on to and chewed (Chapter 3). When considering objects for interactive enrichment, considerations need to be made not only in terms of the positive interactive properties of the object such as manipulation and squeaking, but also any unexpected or unpredictable aspects.

The ability to cope with novelty and the benefit of enrichment to welfare appears to be dependent on both the present environment and past experience. This idea is explored further in Section 9.12.

9.12. Effects of change

Dogs provided with adequate socialisation during the socialisation period and a continuously enriching environment are considered better able to cope with novelty (Appleby and Pluijmakers, 2003). It would therefore be expected that the LSE dogs, as a result of a comprehensive program of socialisation and enrichment (see Section 2.2.2), would be better able to cope with novelty, compared to the RH dogs, many of which are likely to have been abandoned as a consequence of poor socialisation. The LSE dogs did appear more confident and better able to cope with novelty, in terms of a reduced neophobic response, as seen in their preference for unfamiliar over familiar people in terms of duration of interaction (Chapter 4). This supports Kaulfuβ and Mills' (2008) suggestion that neophilia is an adaptive trait present in dogs at aid in adapting to living with humans. However, when offered different enrichments during the choice test (Chapter 6), the dogs showed a reluctance to interact with the potential enrichments offered, instead choosing to remain by the gate awaiting removal from the pen. This was also the case when attempting the pilot habituation study (Chapter 7) with the LSE Miniature Schnauzers. This response would suggest that although better able to cope with the novelty, when placed in a situation they experience on a very rare basis, such as physical social isolation, the dogs altered their behaviour in anticipation of removal from that situation (sitting by the pen gate or trial room door) rather than choosing to interact with the enrichment offered.

Negative past experiences are also likely to affect interaction with potential enrichments. Interaction between the LSE focal dogs and conspecifics was positive in terms of the behaviours observed, with no presence of agonistic interactions. For the RH dogs, lack of socialisation during the socialisation period or a negative (for example aggressive) encounter with a conspecific in the past may have led to conspecific contact being highly stressful rather than enriching (Shepherdson, 2002). This needs to be balanced with the idea that social conspecific contact is important for dogs and should not be restricted solely to human contact, as the two fulfil very different needs (Rooney et al., 2000). Unless the dog is fearful of interaction with any dog then some level of physical conspecific contact should be aimed for.

9.13. Interest outside the kennel

Kennel environments are often seen as unenriching if they are physically barren (Wells, 2004b; Taylor and Mills, 2007). One uncontrollable aspect of the studies carried out, particularly at the RH kennels, was the provision of stimulation (or enrichment) from goings-on outside the kennel itself. Studies have suggested that visual and auditory stimulation are enriching for dogs (Wells and Hepper, 1998; Graham et al., 2005b; Wells et al., 2006), but as has been broached in Section 9.11, these may sometimes be detrimental to welfare in being an uncontrollable element of the environment for the kennel housed dog. The environment beyond the walls of the area to which the animal is confined is likely to be as important in providing a source of enrichment or stress as the direct provision of physical or social enrichment within the pen itself (Newberry, 1995).

The housing design at these kennels was such that in their home pen the dogs were able to maintain visual contact with all the activities going on outside their pen, including carers, dogs and visitors entering the pen area. The kennels were designed as such to provide dogs with enrichment and control over their environment. However, at the RH kennels, the dogs were only able to maintain limited visual contact with dogs and people walking past the kennels. The restricted field of view and their lack of acclimatisation to the environment is likely to have negated the positive effects of this stimulation. This was evident with many of the dogs with the onset of barking and stereotypic behaviour when people and particularly carers with dogs walked past.

As mentioned in Section 9.12, the RH dogs often oriented themselves to the exit gate, interpreted as being more interested in being removed from the unfamiliar trial environment than in the potential enrichments. This suggests that even highly enriched dogs such as the LSE dogs prefer to return to a familiar environment than to interact with potential enrichments in a novel environment. Therefore, trials carried out in the home pen may better predict potential enrichment success long-term.

9.14. Training effects

Training is commonly used as a means of mental stimulation and enrichment for animals housed in captive environments. It is considered to have positive effects on the animals' welfare (Laule and Desmond, 1998). Dogs that become stressed in rehoming centres appear particularly easy to train (Blackwell et al., 2010), suggesting that training may be a way of alleviating stress.

Two of the studies carried out in this thesis (Chapters 6 and 8) relied upon identification of frustration behaviour. However, the anticipation study (Chapter 8) highlighted that widely used training methods that rely on positive reinforcement may inhibit a dog's expression of frustration behaviour in the expected manner, for example, the dogs are trained not to jump up, paw people or bark to get a reward. Although this in itself may not compromise welfare, a canine carer using such methods may need to be aware of more subtle indicators of frustration behaviour in the dog. Regular training sessions, as provided for the LSE dogs, have led to a higher level of exploratory behaviour towards novel objects in dogs (Marshall-Pescini et al., 2008). This could account, to some degree, for the lack of neophobia towards the novel toys outlined in Section 9.11.

In addition to this, some degree of training at both sites may increase expectation of reward and therefore an increased expectation and subsequent 'need' for human social contact. For example, the LSE dogs continued their positive reinforcement training on a daily basis, rewarded with a small quantity of their daily food allocation when a desired behaviour was offered. At the RH kennels, dog biscuits and treats were offered to the dogs intermittently, often as a means of moving a dog from the outdoor to the indoor kennel, or to reward calm behaviour in a reactive dog. In both these cases, rewards generally came from a familiar human, increasing the value of human social interaction.

9.15. Breed differences

The occurrence of breed differences across the LSE population suggests a need to avoid over generalisation not only between kennel environments but also within environments.

Breed differences appeared to reflect the purpose for which the dogs have been bred, for example guarding, herding or retrieving (Hart, 1995a). Although levels of interaction were too low when offered toys (Chapter 3) to allow breed comparisons, during the habituation pilot study (Chapter 7) the Miniature Schnauzers (MS) showed little interest in the soft squeaky toy compared to the Labrador Retrievers (LR). This would suggest that their pattern of response differed and the motivation of the LR to interact with the soft toy was higher due to their retrieving role (Hart, 1995a). This is further confirmed by the choice test (Chapter 6) where the only interactions with the squeaky bone toy were by the LR.

The lack of breed differences for human contact during the choice test (Chapter 6) would suggest that in the short term, social enrichment with humans is equally valued by all breeds. However, slight differences were evident during the human contact trial (Chapter 4) with interest in the human contact by the Cocker Spaniels (CS) waning in favour of being removed from the unfamiliar situation.

Differences between breeds continued during the conspecific contact trials with lower levels of interest both during the conspecific contact trial (Chapter 5) and choice test trial (Chapter 6) by the CS compared to the LR and MS. Since these dogs were from show lines, bred to ignore dogs in the show ring and to focus on a familiar human, this may explain their reduced interest in conspecific contact (Svartberg, 2006). They also appear to have a lower tolerance to novelty in terms of their greater preference to be removed from the trial pen compared to the MS and LR (Chapter 3, 4, 5 and 6).

The lack of difference between breed size groups at the RH kennels is more likely to be indicative of an inappropriate (but unavoidable) grouping of dogs by size rather than breed and the influence of varying past histories. The RH dogs were grouped by size because of the large number of crossbreeds and unknown breeds and therefore there will have been a large number of breed types within each group. Larger sample sizes would have enabled further division by type, and may have produced a breed/size group effect. Highly valued enrichments would be predicted to be less likely to show a breed effect, as in the case of human contact, for example.

Altering the groupings might have produced a breed difference. However, in the majority of cases, a dog would fall into two or more, often unidentifiable breeds or breed groups (e.g. gundogs), therefore reducing the opportunity to group dogs by breed or breed type. So, although in the RH environment, a breed split may not be appropriate, unless large sample sizes are available, the effects of breed on interest in potential enrichment should remain a consideration. It is also worth noting, as was the case in this trial, that toys provided may also need to be altered according to the size of the dog.

9.16. Limitations in the methodology

Overall the methodologies used were successful in determining the initial preference for candidate enrichments in the two kennel environments. The lack of a designated trial area and restrictions at the RH kennels (See Chapter 2) limited the potential to replicate more of the trials at the RH kennels (conspecific contact (Chapter 5), choice test (Chapter 6) and habituation (Chapter 7)). Carrying out all trials at both kennel environments would have provided a further insight into the differences between the two environments. The LSE environment limitations provided different challenges in terms of the experimental design, such as not being able to provide what was considered the optimum toy types for physical enrichment.

A three way split pen would have provided a better trial setup in which to carry out the choice test, allowing direct comparisons between the three potential enrichments. Allowing the person to visually and vocally interact with the focal dog (Chapter 6) in the same way that non-focal dog was able to, may have affected the focal dogs' choice, further biasing them towards human social contact.

Despite a comprehensive trial design, the anticipation trial (Chapter 8) did not achieve the desired anticipation/frustration response at either the RH or LSE kennels. At the RH kennels, it would have been more desirable to have had a week of pre-trial training prior to the trial to build the association between the doorbell and interaction (as was the case for the LSE dogs). This would have required training a much larger sample of dogs to account for the loss of dogs from the trial due to rehoming. For the LSE dogs, the methodology would have needed adapting to assess more subtle behavioural indicators of frustration rather than those expected, such as jumping up.

This thesis has concentrated on the use of behavioural measures of assessing enrichment success. Chapter 1 (Section 1.1.5) outlined the justification for using behavioural measures over physiological or neurological alternatives. However, the use of physiological indicators such as heart rate or cortisol levels may have provided a clearer insight into the difference between the frustration and anticipatory response, if the problems associated with obtaining these measurements could be overcome.

9.17. Further research

This Section does not provide an exhaustive list of the potential research that could be undertake as a follow on from this thesis, but puts forward a number of potential areas of further research.

The research focused around the use of short term measures as a useful indicator of potential enrichment. Longer term trials would allow a further investigation into the sustained interest in enrichment. Having determined the potential enrichment, long-term studies could be used to establish whether those potential enrichments of more interest in the short term, or whether potential enrichment, even if of less interest short term, might continue to be enriching for longer. Once the effectiveness of candidate enrichments was determined longer term, their effectiveness as a means of improving welfare should be determined using a wide range of welfare indicators, since no single universal indicator of well-being has been established for the domestic dog.

Having established that a dishabituation response can be achieved following habituation to a play object (Chapter 7), further studies could focus on the stimulus properties of the object which ignite the dishabituation response. Since manipulating colour and odour of the object both separately and combined produced a similar dishabituation response, it would be interesting to determine how minor the changes to the object can be to produce a dishabituation response. This could be used within the kennel environment to reinstate play without needing to make major changes to the toy and aid in further understanding play structure in dogs.

As mentioned in Section 9.16, the anticipation trial (Chapter 8) has the potential to be modified in order to provide a distinction between frustration behaviours. By determining this, behaviour could be more closely observed to reduce the incidence of frustration behaviours and subsequently improve welfare.

9.18. Summary

This thesis has determined how a number of potential enrichments are utilised by kennel housed dogs as a possible means of improving welfare. Observing dogs housed in two contrasting kennel environments has highlighted the need to use caution when generalising the effectiveness of potential enrichment, not only between kennel environments but also within environments, according to past experience and breed, therefore supporting the hypothesis that the extent to which interaction with potential enrichments occurs is strongly influenced by the kennel environment and the type of enrichment offered. However, this study has also highlighted the importance of the general need for a variety of social and physical enrichments for all kennel housed dogs. When offered a choice between objects, dogs preferred those that could be manipulated and chewed and made a noise over those that did not. However, the dogs studied appeared to prefer social contact with humans and dogs over object enrichment.

Exploration of the habituation response of the dogs has allowed comparisons to the response observed in domestic cats (Hall et al., 2002). This has provided the potential to prolong interest in enrichment objects in the form of play behaviour. Despite being unable to determine the behavioural differences between anticipatory and frustration behaviours, conducting a refined version of this study is likely to provide a valuable insight into such behaviours. The study did suggest the expected frustration behaviours may have been unintentionally reduced due to training for more socially acceptable behaviours in the LSE dogs

Although limited to two kennel environments, this thesis has highlighted the importance of assessing kennel environments individually in terms of potential enrichment success, whilst suggesting areas where broader assumptions can be made (such as the need for social and physical enrichment). The findings of the habituation study (Chapter 7) provides valuable information to better understand the mechanism behind object play and the role of manipulating the habituation and disinhibition responses in prolonging the effectiveness of object orientated enrichment to ultimately improve the welfare of kennel housed dogs.

Appendices

Appendix 1. Summary details of the 107 RH dogs used on trial. Dogs are classified by breed size group: M=medium, L=large and XL=extra large.

Breed size group	Number of dogs (N)	Mean age	Age range	Gender ratio M:F	Neutered M:F
M	28	2.9	1-7	20:8	5:1
L	47	3.4	1-10	29:18	1:2
XL	32	3.4	1-8	22:10	0:2

Appendix 2. Summary details of the 76 LSE dogs used on trial. Dogs are classified by breed group: LR=Labrador Retriever, MS=Miniature Schnauzer and CS=Cocker Spaniel, P=Papillon.

Breed size group	Number of dogs (N)	Mean age	Age range	Gender ratio M:F	Neutered M:F
LR	34	5.4	1-11	16:18	0:5
MS	22	5.6	3-9	11:11	0:3
CS	14	6.4	5-8	10:4	0:0
P	6	7	4-9	4:2	0:0

Appendix 3: Spearman rank correlation of preliminary distance data during interactions with humans for (a) Familiar and unfamiliar interactions combined (b) Familiar interactions only and (c) Unfamiliar interactions only by the 8 RH dogs

(a) Familiar and unfamiliar interactions combined

		Sample 0-2	Sample 2-4	Sample 4-6	Sample 6_8	Sample 8_10
Sample 0-2	Correlation Coefficient	1.000	.810(*)	.738(*)	.476	.690
	Sig. (2-tailed)	.	.015	.037	.233	.058
	N	8	8	8	8	8
Sample 2-4	Correlation Coefficient	.810(*)	1.000	.929(**)	.690	.833(*)
	Sig. (2-tailed)	.015	.	.001	.058	.010
	N	8	8	8	8	8
Sample 4-6	Correlation Coefficient	.738(*)	.929(**)	1.000	.833(*)	.905(**)
	Sig. (2-tailed)	.037	.001	.	.010	.002
	N	8	8	8	8	8
Sample 6_8	Correlation Coefficient	.476	.690	.833(*)	1.000	.810(*)
	Sig. (2-tailed)	.233	.058	.010	.	.015
	N	8	8	8	8	8
Sample 8_10	Correlation Coefficient	.690	.833(*)	.905(**)	.810(*)	1.000
	Sig. (2-tailed)	.058	.010	.002	.015	.
	N	8	8	8	8	8

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

(b) Familiar interactions only

		Sample 0_2_f	Sample 2_4_f	Sample 4_6_f	Sample 6_8_f	Sample 8_10_f
Sample 0_2_f	Correlation Coefficient	1.000	.857(**)	.810(*)	.429	.786(*)
	Sig. (2-tailed)	.	.007	.015	.289	.021
	N	8	8	8	8	8
Sample 2_4_f	Correlation Coefficient	.857(**)	1.000	.952(**)	.690	.833(*)
	Sig. (2-tailed)	.007	.	.000	.058	.010
	N	8	8	8	8	8
Sample 4_6_f	Correlation Coefficient	.810(*)	.952(**)	1.000	.762(*)	.881(**)
	Sig. (2-tailed)	.015	.000	.	.028	.004
	N	8	8	8	8	8
Sample 6_8_f	Correlation Coefficient	.429	.690	.762(*)	1.000	.786(*)
	Sig. (2-tailed)	.289	.058	.028	.	.021
	N	8	8	8	8	8
Sample 8_10_f	Correlation Coefficient	.786(*)	.833(*)	.881(**)	.786(*)	1.000
	Sig. (2-tailed)	.021	.010	.004	.021	.
	N	8	8	8	8	8

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

(c) Unfamiliar interactions only

		Sample 0_2_uf	Sample 2_4_uf	Sample 4_6_uf	Sample 6_8_uf	Sample 8_10_uf
Sample 0_2_uf	Correlation Coefficient	1.000	.881(**)	.786(*)	.476	.500
	Sig. (2-tailed)	.	.004	.021	.233	.207
	N	8	8	8	8	8
Sample 2_4_uf	Correlation Coefficient	.881(**)	1.000	.857(**)	.690	.595
	Sig. (2-tailed)	.004	.	.007	.058	.120
	N	8	8	8	8	8
Sample 4_6_uf	Correlation Coefficient	.786(*)	.857(**)	1.000	.881(**)	.881(**)
	Sig. (2-tailed)	.021	.007	.	.004	.004
	N	8	8	8	8	8
Sample 6_8_uf	Correlation Coefficient	.476	.690	.881(**)	1.000	.857(**)
	Sig. (2-tailed)	.233	.058	.004	.	.007
	N	8	8	8	8	8
Sample 8_10_uf	Correlation Coefficient	.500	.595	.881(**)	.857(**)	1.000
	Sig. (2-tailed)	.207	.120	.004	.007	.
	N	8	8	8	8	8

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Appendix 4: Spearman rank correlation of preliminary distance data during interactions with humans for (a) Familiar and unfamiliar interactions combined (b) Familiar interactions only and (c) Unfamiliar interactions only by the 8 LSE dogs

(a) Familiar and unfamiliar interactions combined

		Sample 0_3	Sample 3_6	Sample 6_9	Sample 9_12	Sample 12_15
sample_0_3	Correlation Coefficient	1.000	.381	.286	.167	.095
	Sig. (2-tailed)	.	.352	.493	.693	.823
	N	8	8	8	8	8
sample_3_6	Correlation Coefficient	.381	1.000	.952(**)	.905(**)	.929(**)
	Sig. (2-tailed)	.352	.	.000	.002	.001
	N	8	8	8	8	8
sample_6_9	Correlation Coefficient	.286	.952(**)	1.000	.976(**)	.905(**)
	Sig. (2-tailed)	.493	.000	.	.000	.002
	N	8	8	8	8	8
sample_9_12	Correlation Coefficient	.167	.905(**)	.976(**)	1.000	.881(**)
	Sig. (2-tailed)	.693	.002	.000	.	.004
	N	8	8	8	8	8
sample_12_15	Correlation Coefficient	.095	.929(**)	.905(**)	.881(**)	1.000
	Sig. (2-tailed)	.823	.001	.002	.004	.
	N	8	8	8	8	8

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

(b) Familiar interactions only

		Sample 0_3_f	Sample 3_6_f	Sample 6_9_f	Sample 9_12_f	Sample 12_15_f
sample_0_3_f	Correlation Coefficient	1.000	.244	.293	.146	.122
	Sig. (2-tailed)	.	.560	.482	.729	.774
	N	8	8	8	8	8
sample_3_6_f	Correlation Coefficient	.244	1.000	.952(**)	.929(**)	.881(**)
	Sig. (2-tailed)	.560	.	.000	.001	.004
	N	8	8	8	8	8
sample_6_9_f	Correlation Coefficient	.293	.952(**)	1.000	.976(**)	.952(**)
	Sig. (2-tailed)	.482	.000	.	.000	.000
	N	8	8	8	8	8
sample_9_12_f	Correlation Coefficient	.146	.929(**)	.976(**)	1.000	.976(**)
	Sig. (2-tailed)	.729	.001	.000	.	.000
	N	8	8	8	8	8
sample_12_15_f	Correlation Coefficient	.122	.881(**)	.952(**)	.976(**)	1.000
	Sig. (2-tailed)	.774	.004	.000	.000	.
	N	8	8	8	8	8

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

(c) Unfamiliar interactions only

		Sample 0_3_uf	Sample 3_6_uf	Sample 6_9_uf	Sample 9_12_uf	Sample 12_15_uf
sample_0_3_uf	Correlation Coefficient	1.000	.539	.587	.443	.371
	Sig. (2-tailed)	.	.168	.126	.272	.365
	N	8	8	8	8	8
sample_3_6_uf	Correlation Coefficient	.539	1.000	.976(**)	.976(**)	.929(**)
	Sig. (2-tailed)	.168	.	.000	.000	.001
	N	8	8	8	8	8
sample_6_9_uf	Correlation Coefficient	.587	.976(**)	1.000	.929(**)	.857(**)
	Sig. (2-tailed)	.126	.000	.	.001	.007
	N	8	8	8	8	8
sample_9_12_uf	Correlation Coefficient	.443	.976(**)	.929(**)	1.000	.976(**)
	Sig. (2-tailed)	.272	.000	.001	.	.000
	N	8	8	8	8	8
sample_12_15_uf	Correlation Coefficient	.371	.929(**)	.857(**)	.976(**)	1.000
	Sig. (2-tailed)	.365	.001	.007	.000	.
	N	8	8	8	8	8

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 5: Median duration (s) of individual behaviours categorised as 'all interaction' at 0-3 min and 9-12 min when interacting with familiar (F) and unfamiliar (UF) conspecific by the 22 LSE focal dogs.

'All Interaction' behaviour	Duration of interaction/s			
	0-3min		9-12min	
	F	UF	F	UF
Playing	0.1	2.8	0	0.9
Mounting	0	0	0	0
Sniffing	4.1	26.5	2.0	0.9
Aggression	0	0	0	0

Appendix 6: Spearman rank correlation of preliminary distance data during conspecific interactions for (a) Familiar and unfamiliar interactions combined (b) Familiar interactions only and (c) Unfamiliar interactions only by the 15 LSE dogs

(a) Familiar and unfamiliar interactions combined

		Sample 0_3	Sample 3_6	Sample 6_9	Sample 9_12	Sample 12_15
Sample 0_3	Correlation Coefficient	1.000	.903(**)	.868(**)	.810(**)	.868(**)
	Sig. (2-tailed)	.	.000	.000	.000	.000
	N	15	15	15	15	15
Sample 3_6	Correlation Coefficient	.903(**)	1.000	.960(**)	.903(**)	.963(**)
	Sig. (2-tailed)	.000	.	.000	.000	.000
	N	15	15	15	15	15
Sample 6_9	Correlation Coefficient	.868(**)	.960(**)	1.000	.940(**)	.925(**)
	Sig. (2-tailed)	.000	.000	.	.000	.000
	N	15	15	15	15	15
Sample 9_12	Correlation Coefficient	.810(**)	.903(**)	.940(**)	1.000	.928(**)
	Sig. (2-tailed)	.000	.000	.000	.	.000
	N	15	15	15	15	15
Sample 12_15	Correlation Coefficient	.868(**)	.963(**)	.925(**)	.928(**)	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.
	N	15	15	15	15	15

** Correlation is significant at the 0.01 level (2-tailed).

(b) Familiar interactions only

		sample_0_3f	sample_3_6f	sample_6_9f	sample_9_12f	sample_12_15f
Sample 0_3f	Correlation Coefficient	1.000	.814(**)	.822(**)	.865(**)	.803(**)
	Sig. (2-tailed)	.	.000	.000	.000	.000
	N	15	15	15	15	15
Sample 3_6f	Correlation Coefficient	.814(**)	1.000	.961(**)	.947(**)	.986(**)
	Sig. (2-tailed)	.000	.	.000	.000	.000
	N	15	15	15	15	15
Sample 6_9f	Correlation Coefficient	.822(**)	.961(**)	1.000	.962(**)	.951(**)
	Sig. (2-tailed)	.000	.000	.	.000	.000
	N	15	15	15	15	15
Sample 9_12f	Correlation Coefficient	.865(**)	.947(**)	.962(**)	1.000	.936(**)
	Sig. (2-tailed)	.000	.000	.000	.	.000
	N	15	15	15	15	15
Sample 12_15f	Correlation Coefficient	.803(**)	.986(**)	.951(**)	.936(**)	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.
	N	15	15	15	15	15

** Correlation is significant at the 0.01 level (2-tailed).

(c) Unfamiliar interactions only

		Sample 0_3uf	Sample 3_6uf	Sample 6_9uf	Sample 9_12uf	Sample 12_15uf
Sample 0_3uf	Correlation Coefficient	1.000	.895(**)	.849(**)	.756(**)	.729(**)
	Sig. (2-tailed)	.	.000	.000	.001	.002
	N	15	15	15	15	15
Sample 3_6uf	Correlation Coefficient	.895(**)	1.000	.969(**)	.845(**)	.886(**)
	Sig. (2-tailed)	.000	.	.000	.000	.000
	N	15	15	15	15	15
Sample 6_9uf	Correlation Coefficient	.849(**)	.969(**)	1.000	.878(**)	.874(**)
	Sig. (2-tailed)	.000	.000	.	.000	.000
	N	15	15	15	15	15
Sample 9_12uf	Correlation Coefficient	.756(**)	.845(**)	.878(**)	1.000	.897(**)
	Sig. (2-tailed)	.001	.000	.000	.	.000
	N	15	15	15	15	15
Sample 12_15uf	Correlation Coefficient	.729(**)	.886(**)	.874(**)	.897(**)	1.000
	Sig. (2-tailed)	.002	.000	.000	.000	.
	N	15	15	15	15	15

** Correlation is significant at the 0.01 level (2-tailed).

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